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INDEX

No separate index is included for the volume. Each number is indexed separately. Contents of the volume are listed in the beginning of the volume.

CONTENTS OF VOLUME LV

Bulletin No.	Plates	Pages
246. Some Late Cenozoic Stony Corals from Northern Venezuela.		
By N. E. Weisbord	1-12	1-288
247. Miocene and Pliocene Mollusks from Trinidad.		
By Peter Jung	13-60	289-657

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Vol. 55

No. 246

SOME LATE CENOZOIC STONY CORALS
FROM NORTHERN VENEZUELA

By

NORMAN E. WEISBORD

1968

Paleontological Research Institution
Ithaca, New York 14850, U.S.A.

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CONTENTS

	<i>Page</i>
Abstract	5
Introduction	5
Acknowledgments	7
Collecting localities	8
List of the stony corals from northern Venezuela	8
Stratigraphy	9
Analysis of the fossils from the Cabo Blanco Group and Guaiguaza Clay	10
Percentage of Recent species by class and formation	14
Systematic descriptions	16
Bibliography	73
Plates	269
Index	282

SOME LATE CENOZOIC STONY CORALS FROM NORTHERN VENEZUELA

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ABSTRACT

Fourteen species of stony corals — 12 of them hermatypic and two ahermatypic — are described, compared, and illustrated. With the exception of one hydrozoan all of the other forms are scleractinians in the class Anthozoa. Nine of the species are fossil, four are Recent, and one is both fossil and Recent. Among the fossils is a new subspecies which is given the name *Manicina arcuata puntagordensis*.

An analysis is made of all of the fossils known to occur in the Cabo Blanco Group, Distrito Federal, and in the Guaiguaza Clay, State of Carabobo. The fossils are tabulated by "Class" and "Formation" to show the percentages of species in each category that have survived to Recent time. It is thought that a more sensitive division of the Cenozoic era into epochs may be worked out by utilizing not only the Mollusca as did Lyell, but other groups of organisms as well.

The Bibliography deals mostly with Cenozoic Anthozoa and Hydrozoa, but other citations applying in one way or another to the present work are included.

INTRODUCTION

The present paper deals with some stony corals, both fossil and Recent, from northern Venezuela, and is the ninth in a series published by the writer since 1957. The fossil corals were collected near La Salina de Guaiguaza in the State of Carabobo, and in the Cabo Blanco area 115 kilometers to the east, in the Distrito Federal. The Recent corals were collected on the beach of the Playa Grande Yachting Club in the Cabo Blanco area, and on the beach at Higuerote 100 kilometers or so to the east-southeast, in the State of Miranda.

Of the 14 species of corals obtained, nine are fossil, four are Recent, and one is both fossil and Recent. Thirteen of the corals are scleractinians, and one is a milleporid hydrozoan. Twelve of the species are hermatypic and two are ahermatypic. Scleractinian corals deposit a heavy exoskeleton of calcium carbonate in the crystalline form of aragonite, and ecologically they are divisible into two groups: hermatypic and ahermatypic. Hermatypic corals live in tropical and subtropical shallow waters of the oceans and contain intracellular symbiotic algae known as zooxanthellae. Some hermatypic species extract calcium from sea water ten times faster in sunlight than in darkness and, under favorable conditions, contribute greatly to the development of coral reefs. Ahermatypic corals, which are found at all latitudes and depths, have no zooxanthellae

and extract calcium from sea water at low rates irrespective of light conditions. The two species of ahermatypic corals described in this work — *Phyllangia americana* Edwards and Haime and *Paracyathus defilippii* Duchassaing and Michelotti were collected from the Maiquetía Member of the Playa Grande Formation and are shallow water forms. The hermatypic corals were collected from the Playa Grande, Mare, and Abisinia Formations of the Cabo Blanco Group, in the Guaiguaza Clay, and on the beaches at Cabo Blanco and Higuerote.

The fossil corals are not abundant either in the number of species or number of specimens, and in this respect the condition is not unlike that off the coast of northern Venezuela today where coral reefs are scattered, small, and patchy. Some of the fossil corals occur in the "*Lithothamnium*" reef of the Maiquetía Member but even here they are relatively scarce. There are only some 55 living species of shallow-water scleractinian corals (Smith, 1954) and perhaps ten hydrocorals in the Western Atlantic from Bermuda through the Gulf of Mexico and the Caribbean to Brazil. Nine of the ten fossil species from the Cabo Blanco-Guaiguaza localities appear to be identical with Recent West Indian species and even the new subspecies *Manicina areolata puntagordensis* seems to be closely related to the *Manicina areolata* of Linnaeus. This suggests that in northern South America there have been few species changes among the stony corals from early Pliocene to Recent time, and that the survival rate of the Scleractinia like that of the Foraminiferida over the last 12 million years or so has been high. In contrast the survival rate of the Mollusca, especially in the class Gastropoda, during the same interval has been considerably lower.

The "synonymy" of a particular species discussed under Systematic Descriptions is, in effect, a list of references to that species, and rests on the opinion of the author responsible for the identification. Under Bibliography, most of the citations refer to publications dealing with Cenozoic corals throughout the world though other references that are peripheral but related to the subject of this work, are included.

The specimens illustrated on Plates 1-12 have been deposited with the Paleontological Research Institution, Ithaca, New York.

The remaining duplicate material is in the Department of Geology, Florida State University, Tallahassee, Florida.

ACKNOWLEDGMENTS

For the help given me in the preparation of this paper I am indebted to John W. Wells of Cornell University, to Donald F. Squires of the U.S. National Museum, to Katherine V. W. Palmer of the Paleontological Research Institution, and to the National Science Foundation.

I wish especially to thank Dr. Wells for checking my identifications and for allowing me free access to his West Indian coral collection and personal library. This work has profited from his observations and comments. Dr. Squires accorded me the excellent working facilities at the U.S. National Museum, and placed at my disposal the Museum's renowned collection of Recent and Tertiary coelenterates to which he has dedicated so much of his efforts. Dr. Palmer once again has taken on the task of editing and publishing, and for this I am grateful. Finally, I wish to express my appreciation to the National Science Foundation for its support of my studies on the late Cenozoic invertebrates of northern Venezuela. The present paper is one of several resulting from that study.

The photographs accompanying this paper were taken and processed by Gerritt Mulders of Tallahassee, and by Werner Vagt of Florida State University.

COLLECTING LOCALITIES

The localities at which the stony corals were collected are listed below and are shown on the geologic map of the writer's 1957 paper. The letter preceding each locality is also used as a prefix for each species number. The specimens obtained at stations "A" and "B" are Recent, at all of the others, fossil. Station "C" is in the state of Carabobo. Stations "D" to "Y" represent formations of the Cabo Blanco Group in the coastal region of Distrito Federal. For each locality the formation and lithology are noted.

- A. Beach at Playa Grande Yachting Club, Distrito Federal. Recent. Moderately coarse and mostly noncalcareous beach sand and calcareous beach rock.
- B. Beach southeast of Higuerote, State of Miranda. Recent. Fine micaceous beach sand.

- C. Drainage ditch, about one meter deep, near south shore of La Salina de Guaiguaza, 5.6 kilometers west of Puerto Cabello, State of Carabobo. Guaiguaza Clay. Gray and brownish clay.
- D. Eastern edge of Playa Grande village at W-30. Abisinia Formation. Granule to pebble gravel.
- H. Fifteen meters south of axis of Punta Gorda anticline near W-25. Mare Formation. Highly fossiliferous wedge of loosely coherent calcareous sandstone.
- I. Hillside above west bank of Quebrada Mare Abajo at W-13. Lower Mare Formation. Uniformly coarse gritty sand.
- J. Small stream 100 meters west of Quebrada Mare Abajo. Lower Mare Formation. Uniformly coarse gritty sand.
- N. Near W-21 and to the south of that station in stream flowing along the north flank of the Litoral anticline. Playa Grande Formation (Catia Member). Tan siltstones and sandstones with knobs of hard sandstone.
- S. On and near the "*Lithothamnium*" reef at W-23, north flank of Punta Gorda anticline. Playa Grande Formation (Maiquetía Member). Reef of calcareous algae with layer of cobbles at base.

LIST OF THE STONY CORALS FROM NORTHERN VENEZUELA

The stony corals described in this paper are listed below. Under the heading Formation, the abbreviation Re refers to Recent; Ab = Absinia Formation; Sal = Guaiguaza Clay; Ma = Mare Formation; PGm = Playa Grande Formation (Maiquetía Member); PGc = Playa Grande Formation (Catia Member). The Abisinia Formation is believed to be early Pleistocene in age, the Guaiguaza Clay late Pliocene, and the Mare and Playa Grande Formations early Pliocene.

Species	Formation	Previously recorded range of known species
HYDROZOA		
<i>Millepora alcinornis</i> Linnaeus	Re	Mio-Plio. - Recent
ANTHOZOA		
<i>Acropora prolifera</i> (Lamarck)	Re	Pleistocene - Recent
<i>Siderastrea</i> (<i>Siderastrea</i>) <i>radians</i> (Pallas)	Re	Miocene - Recent
<i>Siderastrea</i> (<i>Siderastrea</i>) <i>siderea</i> (Ellis and Solander)	PGm	Miocene - Recent
<i>Porites furcata</i> Lamarck	Re	Miocene - Recent
<i>Porites branneri</i> Rathbun	Sal	Recent
<i>Diploria strigosa</i> (Dana)	Re, Ab, PGc	Pleistocene - Recent
<i>Manicina areolata</i> <i>puntagordensis</i> , (n. subsp.	PGm	
<i>Solenastrea hyades</i> (Dana)	Sal, Ma	Miocene - Recent
<i>Solenastrea</i> cf. <i>S. bournoni</i> Edwards and Haime	Ma	Miocene - Recent
<i>Oculina diffusa</i> Lamarck	Ab	Mio-Plio. - Recent
<i>Oculina</i> sp. cf. <i>O. valenciennesi</i> Edwards and Haime	Ma	Recent
<i>Phyllangia americana</i> Edwards and Haime	PGm	Recent
<i>Paracyathus defilippii</i> Duchassaing and Michelotti	PGm	Recent

STRATIGRAPHY

The fossil corals described in this paper were collected from both the Cabo Blanco Group and the Guaiguaza Clay. The stratigraphy of these deposits as established by the writer is summarized below. The thicknesses given are tentative as they are based on surveys and measurements of limited accuracy.

La Salina de Guaiguaza Area
Estado Carabobo

115 kms. Cabo Blanco Area
Distrito Federal

CABO BLANCO GROUP

SUBRECENT

Bench-forming beach rock and reworked clays, sands and gravels. Thickness 3 meters max.

Disconformity

ABISINIA FORMATION

(Lower Pleistocene)

Clays, silts, sands, and gravels, the latter locally with marine fossils. Thickness 13 meters max.

GUAIGUAZA CLAY

(Upper Pliocene)

Gray and brown fossiliferous clays. Thickness exposed in ditch about one meter. (See Weisbord, 1962, p. 23).

Disconformity

MARE FORMATION

(Lower Pliocene)

Uniformly coarse friable sandstone at base grading upward to soft siltstones. Highly fossiliferous. Thickness 19 meters max.

Angular unconformity to
disconformity

PLAYA GRANDE FORMATION

(MAIQUETIA MEMBER)

(Lower Pliocene)

Shales, siltstones, calcareous sandstones, and conglomerates. Bioherms of coralline algae. Fossils moderately abundant. Thickness 68 meters plus.

Fault

PLAYA GRANDE FORMATION

(CATIA MEMBER)

(Lower Pliocene)

Calcareous siltstones and sandstones, conglomerates, some shales and impure limestones, and occasional barnacle coquinas. Fossils moderately abundant, in places occurring as molds and casts. Thickness 156-233 meters.

Angular unconformity
LAS PAILAS FORMATION
(Middle Tertiary)

Nonfossiliferous mudstones, siltstones,
sandstones, and conglomerates. Thick-
ness 375 meters plus.

One of the interesting aspects of the Cabo Blanco Group is that although there is an angular unconformity between the Mare and Playa Grande Formations (see geologic map in Weisbord, 1957) there is a general similarity of their faunas. The two formations are exposed in Quebrada Mare Abajo where the Mare beds, at a higher elevation, dip gently to the north, and the underlying strata of the Maiquetía Member of the Playa Grande Formation dip 24 to 30 degrees to the north. This unconformity, which is clearly displayed, would seem to indicate folding and erosion of the Maiquetía before deposition of the Mare, yet if the fossils are a guide all of these events must have taken place early in Pliocene time. It is suggested that the Playa Grande Formation was laid down in the lower Pliocene and that Mare sedimentation was initiated late in the lower Pliocene or early in the middle Pliocene. This means that if the duration of the whole of the Pliocene epoch was 10 million years or so, the uplift and erosion of the Playa Grande and the initial deposition of the Mare could have been effected within a span of 2 or 3 million years. Whether this interval of diastrophism at the end of the lower Pliocene was local to northern Venezuela or was regional or continental in scope has yet to be determined.

ANALYSIS OF THE FOSSILS FROM THE CABO BLANCO
GROUP AND FROM THE GUAIGUAZA CLAY

In the tables that follow there is listed, under the hierarchy of "Class", the total number of fossil species collected in each formation and the percentage of those species that have survived to Recent time. The purpose of the synthesis is to establish survival percentages for all hierarchies of taxa, and to compare the percentages with those proposed by Sir Charles Lyell for the Mollusca. It was Lyell who first subdivided the Tertiary period into chronologic epochs by determining in a fossil assemblage from a particular stratigraphic unit the per cent of marine mollusks that were still

living (in neighboring seas), and assigning to each of his epochs an age name based on the ratio of Recent forms it contained to the total number of molluscan fossils present. The mollusks were chosen not only because they were abundant and relatively well known, but also because they could be positioned stratigraphically in clearly defined standard geologic sections. Lyell's Tertiary calendar was conceived, in effect, on the evolution, extinction, or survival of animals during the passage of time. Simply stated, the longer the lapse of time the less chance is there for a species to survive to the Recent either because it evolves or because it becomes extinct; conversely, the shorter the lapse of time the greater is the chance for survival, and we know now, thanks to Lyell's guidance, that in Pleistocene deposits more Recent species will be present than in the Pliocene, more in the Pliocene than in the Miocene, and more in the Miocene than in earlier epochs. Lyell's method of relative age determination can be applied logically to organisms other than the Mollusca, but what must be taken into consideration is that longevity varies greatly among animals and that the survival rate among mollusks may be greater or less than for other biologic groups in the same depositional unit. Thus, whereas a 35 per cent survival rate of the mollusks may be indicative of the lower Pliocene in northern Venezuela, a survival rate of 80 per cent of the Foraminiferida is also indicative of the lower Pliocene in northern Venezuela. Therefore once the survival percentages for all classes of organisms within a formation are worked out it should be possible to apply the percentages of one or more groups (*i.e.* 80% Foraminiferida = 35% Mollusca = 60% Bryozoa) in establishing age, and it is to illustrate this concept that the "mortality tables" for the several classes of fossils in the Cabo Blanco Group and Guaiguaza Clay are presented.

In previous publications on the late Cenozoic fossils of northern Venezuela, the data of the percentage tables were compiled solely from my own collections and my own analyses. In the present work, however, I have added data on the Venezuelan Foraminiferida culled from the excellent papers of Bermúdez (1960, 1961) and Bermúdez and Fuenmayor (1962, 1966), in which 145 species (140 of them from the Playa Grande formation and 72 of them from the Mare Formation) are identified, described and discussed, and the new species illustrated.

The ages assigned to the formations of the Cabo Blanco Group (lower Pleistocene for the Abisinia Formation and lower Pliocene for the Mare and Playa Grande Formations) are based on the percent of Recent species of Mollusca contained in them. This judgment is reinforced in some measure by stratigraphic evidence which clearly indicates that the Abisinia Formation overlies the Mare, and that the Mare overlies the Playa Grande. The assignment of an upper Pliocene age for the Guaiguaza Clay is also based on the Mollusca, but unlike in the Cabo Blanco area, field evidence in the form of natural exposures is wanting.

It may be noted, in referring to the percentage tables, that generally, as well as specifically for the classes Gastropoda, Pelecypoda, Foraminiferida, and others, there is a successively larger number of Recent species from the older to younger formations of the Cabo Blanco Group. This confirms, of course, the whole point of Lyell's principle — that the younger a Tertiary deposit is the more species that are still living (Recent) will it contain. However, the survival rate of organisms is not the same in all taxonomic hierarchies or in all regions. Lyell's divisions were proposed on the survival rate of molluscan species in sections in Italy and France, and on a reasonable but somewhat arbitrary percentage scale for each epoch. Lyell might just as well have taken as his standard the Paleocene to Pleistocene sections from Louisiana to Florida in the Gulf Coast of the United States, and would have arrived at a similar conclusion: the younger the beds the greater the number of Recent species would it contain regardless of the taxon or taxa considered. Not only that, but a somewhat arbitrary bracket of percentages for each class of organisms would have had to be imposed for each epoch. These percentages may differ locally, regionally, and globally for even a single class of organisms, but I rather suspect that if all taxa in a given formation were determinable it should be possible to apply Lyell's law for smaller and smaller divisions of Tertiary time as it has for the major divisions of the Tertiary period.

Focussing on the particular as it relates to northern Venezuela, it is seen that the most highly fossiliferous unit of the Cabo Blanco Group is the Mare Formation. The most numerous of the 322 fossils now known are the 230 mollusks divided among the classes Scapho-

poda (8 species), Gastropoda (140 species), and Pelecypoda (82 species). Considering the phylum Mollusca as a whole, 26 to 40 per cent of the species are known to be living today, and on this ratio the Mare Formation is assigned a lower Pliocene age. The next largest class represented is the Foraminiferida with 72 species of which 60 or 83 per cent are found in the Recent. In decreasing order of abundance are the bryozoans (class Gymnolaemata) with 10 species of which 60 per cent are living, the barnacles (Cirripedia) with 5 species of which 20-40 per cent are living, the corals (Anthozoa) with 3 species of which 100 per cent are living, and 2 serpulid worms (Polychaetia) of which 50 per cent are living.

Extrapolating from the data given for both the Mare and Playa Grande Formations, I would expect, given a large enough fossil assemblage to work with, that in northern Venezuela and perhaps in the circum-Caribbean region, lower Pliocene sediments would be represented by a molluscan fauna with about 38 per cent of the species occurring in the Recent, and by about 80 per cent of the Foraminiferida (including both pelagic and benthonic forms). With considerably less data to go on, the corals of the lower Pliocene of Venezuela might include 75 per cent of Recent species, the bryozoans about 45 per cent, barnacles around 20 per cent, and serpulid polychaetes roughly 25 per cent.

Organisms with a short life span are better time-markers than long-lived ones, but the latter are still subject, over a longer period of time, to the same cycle of genesis, proliferation, and extinction or evolution as the former. The Foraminiferida of the lower Pliocene in northern Venezuela have a far greater per cent of Recent species than any class in the Mollusca and, in fact, the percentages are so high from the late Miocene on, that micropaleontologists have been reluctant in the past to use the smaller foraminifers as age indicators. Nevertheless the percentage of extinct or Recent species in each epoch or smaller division of Tertiary time is fixed in a sense by natural law, and although the percent of Recent foram species is high in the Miocene it is *statistically* higher in the Pliocene and still higher in the Pleistocene. Reciprocally, the *extinction* per cent is measurably higher the farther and farther back we go from the datum of Recent time, and it matters little what group or groups of

fossils are dealt with in dating the Tertiary so long as a sufficient number of species are available to insure statistical validity.

PERCENTAGE OF RECENT SPECIES BY CLASS AND FORMATION

Abisinia Formation (Lower Pleistocene)

Class or Order	Total number of species	Number of Recent species	Per cent of Recent species
Anthozoa (Scleractinia)	2	2	100
Gymnolaemata (Cheilostomata)	1	1	100
Polychaeta (Sedentaria)	1	1	100
Cirripedia	1	1	100
Gastropoda	34	26-31	76-88
Pelecypoda	18	15-16	83-90
Total	57	46-52	81-91

Guaiguaza Clay (Upper Pliocene)

Class or Order	Total number of species	Number of Recent species	Per cent of Recent species
Anthozoa (Scleractinia)	2	2	100
Scaphopoda	2	1	50
Gastropoda	25	9	36
Pelecypoda	14	11	79
Total	43	23	53

Mare Formation (Lower Pliocene)

Class or Order	Total number of species	Number of Recent species	Per cent of Recent species
Foraminiferida	72	60	83
Anthozoa (Scleractinia)	3	3	100
Gymnolaemata (Cheilostomata)	10	6	60
Polychaeta (Sedentaria)	2	1	50
Cirripedia	5	1-2	20-40
Scaphopoda	8	4-5	50-63
Gastropoda	140	23-52	16-34
Pelecypoda	82	32-38	39-46
Total	322	130-167	40-52

Playa Grande Formation (Undifferentiated)
(Lower Pliocene)

Class or Order	Total number of species	Number of Recent species	Per cent of Recent species
Chlorophyceae (Dasycladales)	1	—	—
Foraminiferida	140	106	76
Anthozoa (Scleractinia)	5	4	80
Gymnolaemata (Cheilostomata)	6	3	50
Polychaetia (Sedentarida)	4	—	—
Cirripedia	8	2	25
Scaphopoda	9	3-5	33-55
Gastropoda	84	9-20	11-24
Pelecypoda	72	30-37	42-52
Total	329	157-177	48-54

Playa Grande Formation (Maiquetía Member)
(Lower Pliocene)

Class or Order	Total number of species	Number of Recent species	Per cent of Recent species
Chlorophyceae (Dasycladales)	1	—	—
Anthozoa (Scleractinia)	4	3	75
Gymnolaemata (Cheilostomata)	4	3	75
Polychaetia (Sedentarida)	1	—	—
Cirripedia	3	0-1	0-33
Scaphopoda	6	3	50
Gastropoda	79	7-25	9-32
Pelecypoda	53	23-29	47-60
Total	151	39-64	26-43

Playa Grande Formation (Catia Member)
(Lower Pliocene)

Class or Order	Total number of species	Number of Recent species	Per cent of Recent species
Anthozoa (Scleractinia)	1	1	100
Gymnolaemata (Cheilostomata)	2	—	—
Polychaetia (Sedentarida)	3	0-1	0-33
Cirripedia	6	1	16
Scaphopoda	2	1	50
Gastropoda	5	0-2	0-40
Pelecypoda	26	8-10	31-40
Total	43	11-15	26-35

SYSTEMATIC DESCRIPTIONS
COELENTERATA
HYDROZOA
MILLEPORINA

Millepora alcornis Linnaeus

Pl. 1, figs. 1-4

- 1707-25. *Corallium asperum candicans adulterinum*, Sloane, A Voyage to the Islands of Madera, Barbados, Nieves, S. Cristophers and Jamaica, pl. 17, fig. 1; pl. 18, fig. 1; pl. 19. [Fide Boschma, 1948, pp. 23, 25.]
1758. *Millepora alcornis* Linnaeus, Systema Naturae, ed. 10, p. 791.
1766. *Millepora alcornis* Linnaeus, Pallas, Elenchus Zoophytorum, p. 260.
1767. *Millepora alcornis* Linnaeus, Systema Naturae, ed. 12, pt. 2, p. 1282.
1771. *Millepora alcornis* Linnaeus, Knorr, Deliciae Naturae [Dordrecht], pl. A6, fig. 3. [Fide Boschma, 1948a, pp. 23, 26.]
1789. *Millepora alcornis* Linnaeus, Browne, P., The Civil and Natural History of Jamaica, Index III, Index IV.
- 1790, 1796. *Millepora alcornis* Linnaeus var. *digitata*, *corniculata*, *ramosa*, Esper, Die Pflanzenthier, vol. 1, pt. 6, pp. 193-202; Esper, Fortsetzungen der Pflanzenthier, *Millepora*, pls. 5, 6, 7. [Fide Deshayes and Edwards in Lamarck, 1836, p. 308, and Boschma, 1948a, pp. 23, 26.]
1816. *Millepora alcornis* Linnaeus, Lamarck, Hist. nat. Anim. sans Vert., ed. 2, p. 308.
- 1829-39. *Millepora alcornis* Linnaeus, Guérin-Ménéville, Iconographie du Règne Animal de G. Cuvier, pl. 3, fig. 11.
1834. *Palmipora alcornis* (Linnaeus), Blainville, Manuel d'Actinologie ou du Zoophytologie, pl. 58, fig. 2.
1836. *Millepora alcornis* Linnaeus, Deshayes and Edwards in Lamarck, Hist. nat. Anim. sans Vert., ed. 2, vol. 2, p. 308.
- 1836-49. *Millepora alcornis* Linnaeus, Edwards in Cuvier, Le Règne Animal, 3d ed., vol. 10, pl. 89, fig. 1.
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The single corallum in the collection is an upstanding arborescent plate. The main branches of the plate are flattened and irregularly fused at the base and upward, but are separated into individual or dichotomous fronds at the growing edge. Subsidiary branches project outward and upward from the colony, and these branches are often rounded and obtusely pointed at the tip. The coenosteum is completely pitted by minute subrounded cavities between the trabeculae. The outline of the dactylopores and gastropores is generally irregular though occasionally it is stellate, the stellate appearance having been produced fortuitously by the manner in which the trabeculae were corroded. The alveolae are circular in outline and occupy moderately deep hemispherical depressions. The distribution of the alveolae is erratic; on some areas of the corallum they are so crowded they nearly touch one another, but on others they are scarce or absent. Several alveolae with a calcified membrane have been noted, and these display a radial structure. Occasionally a number (five to seven or so) of dactylopores forming a cycle around a gastropore can be observed, but clearly defined cyclosystems are the exception.

Measurements. — Specimen B562a: corallum (broken off at base) height 50 mm, width 54 mm, thickness at base 5 mm; diameter of dactylopores 0.11 mm to 0.14 mm; diameter of gastropores 0.21 to 0.29 mm; diameter of alveolae 0.32 mm to 0.50 mm.

Locality. — Washed up on beach southeast of Higuierote, State of Miranda. One dead Recent specimen.

Remarks. — It is difficult to identify Western Atlantic species of *Millepora* with assurance, but the single specimen is so close to what Vaughan (1902a, pls. 35, 37, 38) referred to as the digitiform variety of *M. alcicornis* and so similar to the *M. alcicornis* illustrated by Boschma in his figure 76A on page F92 of the Treatise of Paleontology (1956) that I refer the Venezuelan specimen to that species.

The species of *Millepora* in the Western Atlantic are *M. alcornis* Linnaeus, *M. complanata* Lamarck, *M. squarrosa* Lamarck, *M. braziliensis* Verrill, and *M. nitida* Verrill. All of these are similar in some aspects but may be distinguished perhaps by a salient character or two as noted below.

M. alcornis. The corallum is an upstanding plate composed of flattened and fused fronds which are often digitiform at the growing edge. Secondary, antler-like branches may also be present.

M. complanata. The corallum consists of thin upstanding plates, the free edge of which is usually truncated. The dactylopores and gastropores are generally stellate.

M. squarrosa. The corallum forms a broad upstanding plate with thin edges and is covered by irregular ridges and tubercles.

M. braziliensis. The corallum consists of thick erect branches. The surface is uneven.

M. nitida. The corallum forms low rounded clumps which have smooth surfaces, and are obtuse, rounded, or even clavate at the ends.

Range and distribution. — The geologic range of *Millepora alcornis* Linnaeus is Mio-Pliocene to Recent.

The geographic extent of the living form of *M. alcornis* is now believed to be confined to the Western Atlantic between Bermuda on the north and northern South America on the south. Specific regions are the following: Bermuda; the Bahamas (Bimini area at Rabbit Cay, Turtle Rocks, South Bimini, Abaco, Harrington Sound, and Moselle Bank); Florida (the Keys and Tortugas); Mexico (Alacran Reef); British Honduras (Lighthouse and Glover's Reefs, Rendezvous Cay); southeast of Cuba; Jamaica (Ocho Rios and Pelican Cay Reefs: on the former the species has been found on the back reef, the reef crest, the buttress zone, and the seaward slope); Panama Canal Zone; Colombia (Cartagena); Puerto Rico (Mayaguez, La Parguera, and Culebra); St. Thomas; St. Eustatius; Guadeloupe; Curaçao; Bonaire; Antigua; Barbados (2-6 fathoms); Trinidad; and possibly Brazil.

The Pleistocene locality is Mt. Hope in the Panama Canal

Zone, and the upper Miocene-Pliocene locality is Cubagua, Venezuela. It has been pointed out by Wells (*in* Woodring, 1957, p. 21) that there is an *alcicornis*-like *Millepora* in the Gatuncillo Formation (middle-upper Eocene) of the Madden Basin, Panama.

The skeleton of the living *M. alcicornis*, a hydrozoan, is composed entirely of aragonite like many Recent species of scleractinian corals.

Synonymy.—The following forms are considered by Boschma (1948a) and others to be synonymous with *M. alcicornis*: *M. candida* Duchassaing and Michelotti, *M. carthaginiensis* Duchassaing and Michelotti, *M. crista-galli* Duchassaing and Michelotti, *M. crustacea* Esper, *M. delicatula* Duchassaing and Michelotti, *M. digitata* Duchassaing and Michelotti, *M. esperi* Duchassaing, *M. fasciculata* Duchassaing, *M. forskali* Milne Edwards, *M. gothica* Duchassaing and Michelotti, *M. moniliformis* Dana, *M. pumila* Dana, *M. ramosa* Pallas, *M. schrammi* Duchassaing and Michelotti, and *M. trinitatis* Duchassaing and Michelotti.

ANTHOZOA SCLERACTINIA

Acropora prolifera (Lamarck)

Pl. 2, figs. 1-3

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- 1919a. *Acropora prolifera* (Lamarck), Vaughan, U.S. Nat. Mus., Bull. 103, No. 9, pp. 480, 482.
- 1927b. *Acropora prolifera* (Lamarck), van der Horst, Bijdr. Dierk. Amsterdam, vol. 25, p. 161.
1939. *Acropora muricata* var. *prolifera* (Lamarck), Butsch, Barbados Mus. Nat. Hist. Soc., Jour., vol. 6, No. 3, p. 137, pl. 2, fig. 2.
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1964. *Acropora prolifera* (Lamarck), Rivero, Geos [Venezuela], No. 11, p. 113.

The single specimen collected is so worn that the identification is provisional. The small, broken corallum is branched, with two of the branches diverging from the larger stem in the form of a "V". The branches are cylindrical, gently tapering, and subcircular in cross section, consisting of an axial corallite with somewhat smaller radial corallites around it. The corallites are worn down to low mounds or protuberances but normally they must have formed tubular projections scattered all over the branches as well as at the end of the branches. The calices are less than 2 mm in diameter, and the 12 septa are well developed. The corallites grow at an angle to the branch, and as the corallites have been worn down to the degree that their calices are now parallel with the branch, the columella appears to be off-centered.

Measurements. — Specimen B563a: length of largest branch of corallum (broken at both ends) 46 mm; diameter of branch at large end 9 mm, at small end 5 mm; average diameter of axial calice 1.1 mm, of radial calice 0.7 mm.

Locality. — Washed up on beach southeast of Higuerote, State of Miranda. One dead specimen. Recent.

Comparisons. — It is difficult to determine with assurance whether the Higuerote specimen is *Acropora prolifera* (Lamarck) or *Acropora cervicornis* (Lamarck). Vaughan (1902a, p. 313) differentiated *A. prolifera* by its more crowded branches, a character that the Venezuelan form seems to display. As the two species are close, citations to *A. cervicornis* are appended below.

Remarks.—*Acropora prolifera* (Lamarck) was originally known as *A. muricata* (Linnaeus). The *A. muricata* complex in the West Indies was later subdivided into *A. cervicornis*, *A. prolifera*, and *A. palmata* by Lamarck. Subsequently, and largely through the work of Brook (1893b), these three American species were again united under the name of *A. muricata* (Linnaeus), a name which found acceptance by a number of authors. In 1900a, however, Gregory reapplied the individual Lamarckian names to the three species, and that trend has persisted to the present.

Range and distribution.—The range of *Acropora prolifera* (Lamarck) is Pleistocene to Recent, the Pleistocene form reported from the Fresh Creek fossil reef on Andros Island, the Bahamas. The living *A. prolifera* is known from the Bahamas, Florida (Tortugas), Mexico (off Vera Cruz), British Honduras (Rendezvous Cay, Turneffe, Pedro Bank), Jamaica (on the well-sheltered inner reef of Portland Bight), Haiti, Puerto Rico (Culebra), St. Thomas, Curaçao (Caracas Bay), Venezuela (Puerto La Cruz), and Barbados (1-8 fathoms).

Addendum.—References to *Acropora cervicornis* (Lamarck) are the following:

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1758. *Millepora muricata* (pars) Linnaeus, Systema Naturae, ed. 10, vol. 1, p. 792.
1766. *Madrepora muricata* (Linnaeus), Pallas, Elenchus Zoophytorum, p. 327. [*Fide* Vaughan, 1902a, p. 313.]
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The range of *Acropora cervicornis* (Lamarck) is Pleistocene to Recent. The living form is known from the Bahamas (Bimini) to Barbados, with intervening localities at Florida and the Tortugas (2-10 fathoms), Mexico (Blanquilla and Alacran Reefs), British Honduras (Rendezvous Cay, Turneffe, Lighthouse Reef, Glover's Reef, Pedro Bank), Cuba, Jamaica, Puerto Rico (off Gallardo Bank, 10 fathoms), Antigua, St. Thomas, Curaçao (3-6 fathoms), and Venezuela (Tortuga and Margarita Islands).

According to Vaughan (1918, p. 482), the *A. cervicornis* variant of *A. muricata* occurs in the Pleistocene of Moín Hill (Costa Rica), at Mount Hope in the Panama Canal Zone, and "is general in the West Indian and eastern Central American Pleistocene reefs where they were not exposed to the beat of the heavy surf." The species is also known from the Pleistocene of the Fresh Creek fossil reef in the Great Bahama Bank (Newell and Rigby, 1957), in the Key Largo Limestone of Florida (Stanley, 1966), at Sugar Loaf in the Island of St. Eustatius (Westermann and Kiel), from the Island of Guadeloupe, and in uplifted reefs in Barbados (Mesolella, 1967).

Siderastrea (Siderastrea) radians (Pallas)

Pl. 2, figs. 4, 5

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The single Venezuelan specimen collected is a young one. The corallum is encrusting, cerioid, slightly hemispherical and undulatory, and ash gray in color. The calices are subhexagonal in outline, with diameters ranging from 2.8 mm to 4.5 mm. There are 26 to 36 septa in four cycles, the last cycle incomplete. The summits of the septa are nearly horizontal at the boundary of the adjoining calice, but inward toward the columella they steepen, gradually at first but then precipitously at the columellar cavity. The sides of the septa are vertical and are studded with small pointed nodules; the upper margins are serrulated by small denticles of which there are 12 or so on the longer septa. The columella is small and papillose.

Measurements.—Specimen B569a: corallum length 25 mm, width 23 mm, thickness 4 mm; length of calices 3.1 mm to 4.5 mm, width 2.8 mm to 3.7 mm.

Locality.—Washed up on beach southeast of Higuerote, State of Miranda. One dead specimen. Recent.

Comparisons.—*Siderastrea radians* (Pallas) is often found with, and closely resembles *Siderastrea siderea* (Ellis and Solander). It is distinguished from *S. siderea* by its deeper and narrower columellar cavity, and by its smaller calices with fewer septa; there are always fewer than 48 septa on adults of *S. radians*, as compared with 48 or more on *S. siderea*. Another similar species is *S. stellata* Verrill from Albrolos Reef and Bahía, Brazil, but that has longer calices (up to 6 mm), more coarsely dentate septa, and a less developed columella than *S. radians*.

S. radians is essentially a near-shore species occupying a variety of habitats from strong surf at one extreme to sediment-laden waters at the other.

Range and distribution.—If the *S. galaxea* reported by Pourtales from the Dominican Republic is synonymous with *S. radians*, as most authors believe, then *S. radians* ranges from Middle Miocene to Recent.

The living form of *S. radians* is common in the Western Atlantic in shallow water, and has been reported from the Red Sea, off the Islands of San Thomé and Fernando Po in the Gulf of Guinea, and in the Cape Verde Islands. Western Atlantic localities are Bermuda (Gallows Island); the Bahamas (Harrington Sound,

Bimini, Abaco); the Florida Keys (Spanish Harbor); the west coast of Florida (St. George's Sound); the Tortugas (Bird Key Reef, Loggerhead Key, Fort Jefferson); Mexico (Vera Cruz, Isla Verde, Isla de Lobos, Alacran Reef); Panama; British Honduras (Rendezvous Cay, Turneffe); Cuba; Puerto Rico (tide pools, back-and-patch reefs, cays); Jamaica (Kingston 5-6 ft.); St. Thomas; Guadelope; Curaçao (Westpunt Baai, St. Michaels Baai, Piscadera Baai, Spanish Water); and Barbados. The Pleistocene *S. radians* occurs in the Bahamas (Fresh Creek fossil reef); Florida (Key Largo Limestone); the Panama Canal Zone (Mt. Hope); Curaçao; and the Barbados in low level reefs. *S. radians* from the Mio-Pliocene of Cubagua Island, Venezuela is noted by Rivero (1964), and the Miocene *S. galaxea* (Ellis and Solander), which is placed in synonymy with *S. radians* (Pallas), was reported by Pourtalès in 1875 from the Dominican Republic.

Siderastrea (Siderastrea) siderea (Ellis and Solander) Pl. 3, figs. 1-5

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The corallum is large, massive, and cerioid, and is probably hemispherical in shape though it is so corroded and riddled by large burrows of a boring pelecypod that its true form cannot be made out. The corallites are tall, moderately slender, crowded, and unequal. The calices are irregularly pentagonal or hexagonal, seemingly

shallow, separated by a thin but well-defined common wall, and range from about 5 mm to 6 mm in length and about 4 mm to 5 mm in width. The septa of adjoining calices abut against the wall (which is flush with the surface) and oppose each other end to end or are alternate in position. The number of septa, which depends in part on the dimensions of the calice, varies from 42 to 70. In the average mature calice there are 55 to 60 septa or 10 to 11 septa per millimeter length of the calice. There are four complete cycles of septa plus a number of quinarys, but in small calices the fourth cycle may be incomplete in some systems. The septa are thin and closely spaced, the primary ones reaching the columella but the tertiarys fused with the secondarys part way along the length of the latter, and the quaternarys fused with the tertiarys. The septa are dentate along the summit, with 12 to 14 pairs of slightly staggered, diminutive, laterally projecting denticles on the longest septa some 2 mm or so in length. The sides of the septa are granulate. The columella is small and its structure in the upper part obscured by the simple convergence of the primary septa.

The synapticalae are rather regularly disposed and extend from the wall about three-fourths the distance to the columella, with six or seven of them present between septa of full length. The costae are finely and coarsely tuberculate, the tubercles large in some series, small in others. The tubercles are arranged in oblique or not quite vertical columns along the length of the costae, and in a costa 0.7 mm in width there are four rows of tubercles, those in the two middle columns large, the ones in the outer columns small. On some of the costae small tubercles alternate with large ones in the same column. Lengthwise along the costae there are five large tubercles in one millimeter of length, and depending on their location, as many as seven small tubercles in one millimeter of length. A number of the larger tubercles are perforate.

Measurements.—Specimen S567a: corallum length 78 mm, width 63 mm, height 86 mm.

Locality.—Playa Grande Formation (Maiquetía Member) at W-23, north flank of Punta Gorda anticline at *Lithothamnium* reef. One specimen.

Remarks.—The few calices that can be seen on the Venezuelan

specimen are extremely shallow, but they are all corroded, and none of them is on a fresh surface. Their true configuration therefore is not known. It is assumed, however, that the calices normally are fairly deep as on *Siderastrea siderea* (Ellis and Solander), and as all other characters conform to *S. siderea*, the Venezuelan fossil is referred to that species.

Range and distribution.—The range of *Siderastrea siderea* is Miocene to Recent. The Miocene form is found in Cuba, Jamaica (Bowden), Haiti, the Dominican Republic (Zone H, Rio Cana), Vieques Island, and Trinidad. The Pliocene locality is Cabo Blanco, Venezuela (this report). In the Pleistocene the species has been recorded from Bermuda, the Bahamas, Florida, the Panama Canal Zone (Mt. Hope), Costa Rica, Cuba, Jamaica, the Dominican Republic (Barahona), St. Eustatius, Curaçao, Aruba, and Barbados (in reefs up to 480 feet in elevation). In the Western Atlantic the living form is reported from Bermuda, the Bahamas, Florida (Tortugas), Mexico (Blanquilla and Alacran Reefs, Isla de Lobos, and off Vera Cruz), Panama, British Honduras (Rendezvous Cay, Lighthouse Reef, Glover's Reef, and Pedro Bank), Jamaica, Puerto Rico (Culebra), St. Thomas, Venezuela (Puerto La Cruz and Tortuga), Curaçao, and Barbados (1 to 10 fathoms).

The living *Siderastrea siderea* has also been reported from the Red Sea, Cape Verde Islands, the Gulf of Guinea, and off the Island of San Thomé.

Porites furcata Lamarck

Pl. 4, figs. 1-4

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1866. *Porites furcata* Lamarck, Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., vol. 23, p. 189.
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1888. *Porites furcata* Lamarck, Rathbun, U.S. Nat. Mus., Proc., vol. 10, pp. 361-364, pl. 15, figs. 1-3; pl. 17, fig. 1.
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- 1915c. *Porites furcata* Lamarck, Vaughan, Washington Acad. Sci., Jour., vol. 5, p. 597.
- 1915a. *Porites furcata* Lamarck, Vaughan, Carnegie Inst. Washington, Yearbook No. 13, pp. 224, 225.
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- 1916b. *Porites furcata* Lamarck, Mayer, Carnegie Inst. Washington, Yearbook No. 14, p. 212.
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- 1919a. *Porites furcata* Lamarck, Vaughan, U.S. Nat. Mus., Bull. 103, No. 9, p. 499.
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- 1964a. *Porites furcata* Lamarck, Goreau, Science, vol. 145, No. 3630, p. 385.
1964. *Porites furcata* Lamarck, Storr, Geol. Soc. Amer., Spec. Papers, No. 79, pp. 45, 46, 74, 80, 84, 86.

1964. *Porites furcata* Lamarck (*pars*), Roos, Studies on the Fauna of Curaçao and other Caribbean Islands, vol. 30, No. 81, p. 10.
1965. *Porites furcata* Lamarck, Kissling, Bull. Marine Sci., vol. 15, No. 3, p. 603.
1966. *Porites furcata* Lamarck, Stanley, Amer. Assoc. Petrol. Geol., Bull., vol. 50, No. 9, p. 1931, pl. 1, fig. 14.
1966. *Porites furcata?* Lamarck, Rigby and McIntire, Brigham Young Univ., Geol. Studies, vol. 13, p. 32.

The single Recent specimen consists of one irregular branch bent in the middle, broken off at the attached end, slightly dilated as well as blunted at the free end, and subcircular in cross section. The calices are shallow, pentagonal to hexagonal in outline, and joined by a common wall which is thin. The columella is represented by a tubercle or opening around which there are generally five pali. In most calices there are 12 denticulate septa, but in an occasional one there may be up to 15. The color of the corallum is a faded cream.

Measurements.—Specimen A575a: Length of branch 32.5 mm, diameter at broken end 7.5 mm, diameter at larger end 11.5 mm; diameter of calices at larger end of branch 1.29 mm to 1.57 mm; thickness of wall between calices 0.011 mm to 0.018 mm.

Locality.—Washed up on beach at Playa Grande Yachting Club, Distrito Federal. One dead specimen. Recent.

Comparisons.—Specimen A575a closely resembles the following: *Porites porites* (Pallas) illustrated by Smith (1948, pl. 10); *Porites porites* forma *furcata* Lamarck illustrated by Vaughan (1902, pl. 30; pl. 31, fig. 1); *Porites porites* var. *furcata* Lamarck illustrated by Squires (1959a, pl. 39, fig. 1); and the *Porites furcata* Lamarck illustrated by Rathbun (1888b, pl. 17, fig. 1). I would unhesitatingly identify the Venezuelan form as *Porites furcata* were it not for the fact that the free end of the branch is somewhat dilated as in *P. porites* rather than tapered to a slightly smaller diameter as it generally is in *P. furcata*. However, the calices are a little smaller than in the typical *P. porites*, and there are generally five pali instead of six as there often are in *P. porites*. In *P. clavaria* Lamarck the calices range from 1.5 to 2.0 mm in diameter, and there are also six pali. References to *P. clavaria* Lamarck prior to 1895 and a discussion of that species are given by Gregory (1895, pp. 282-284). The corallum of *P. divaricata* Lesueur is composed of thin delicate branches less than 6 mm in diameter, whereas on the Venezuelan form the diameter is 7.5 mm to 11.5 mm. In most respects, there-

fore, the Venezuelan specimen here described is closest to *Porites furcata* Lamarek.

Range and distribution.—The geologic range of *P. furcata* is given as Miocene to Recent. The living species has been recorded from the Bahamas to Barbados in depths of 1.5 feet to over 60 feet (10 fathoms). The localities are the following: Bahamas; Florida (Spanish Harbor off Big Pine Key, and the Tortugas); Mexico (Blanquilla and Alacran Reefs, Isla de Lobos?, and off Vera Cruz where specimens are washed up on the shingle banks of Isla Verde and Isla Sacrificios, possibly from Anegada Reef); British Honduras (Rendezvous Cay and Glover's Reef); Cuba; Jamaica; Curaçao (Spanish Water, Caracas Bay); St. Thomas; Venezuela (Puerto La Cruz); and Barbados.

The Pleistocene form of *P. furcata* has been reported from the Key Largo Limestone of Florida; from Moín Hill, Costa Rica (at *niveau* "a" of Pittier); from Mount Hope in the Panama Canal Zone; from the Dominican Republic (Barahona); and from the "West Indies and eastern Central America" (Vaughan).

In the Miocene *P. furcata* was found in the Dominican Republic by Gabb (1875), and a form resembling *P. furcata* has been reported in the Thomonde Formation of Haiti by Woodring.

Porites branneri Rathbun

Pl. 10, fig. 4

- 1888b. *Porites branneri* Rathbun, U.S. Nat. Mus., Proc., vol. 10, pp. 355, 356, pl. 19, fig. 2.
- 1901a. *Porites branneri* Rathbun, Vaughan, R. Mus. Geol. Min. Leiden, Samml., ser. 2, vol. 2, pp. 76, 77.
- 1901b. *Porites Branneri* Rathbun, Verrill, Connecticut Acad. Arts Sci., Trans., vol. 11, pt. 1, pp. 162-163, pl. 31, figs. 6-6a.
- 1901c. *Porites Branneri* Rathbun, Verrill, Connecticut Acad. Arts Sci., Trans., vol. 11, pt. 1, art 4, p. 196.
- 1902a. *Porites branneri* Rathbun, Vaughan, U.S. Fish Comm., Bull., vol. 20 for 1900, pt. 2, p. 317.
- 1904. *Porites branneri* Rathbun, Greeley, in Branner, Mus. Comp. Zool., Bull., vol. 44, Geol. Ser., vol. 7, pp. 268, 269, 270, 272.
- 1906. *Porites Braziliensis secunda* Bernard (= *Porites branneri* Rathbun), Catalogue of the Madreporarian Corals in the British Museum (Natural History), vol. 6, pp. 29, 30.
- 1927b. *Porites branneri* Rathbun, van der Horst, Bijdr. Dierk. Amsterdam, vol. 25, p. 161.
- 1948. *Porites branneri* Rathbun, Smith, Atlantic Reef Corals, pp. 60, 71, 80.
- 1954. *Porites branneri* Rathbun, Smith, U.S. Fish and Wildlife Serv., Fish. Bull., vol. 55, No. 89, p. 293.
- 1958a. *Porites branneri* Rathbun, Zans, Geol. Sur. Dept. Jamaica, W.I., Bull. No. 3, 31.

1962. *Porites branneri* Rathbun, Stoddart, Atoll Research Bull., No. 87, p. 19.
1964. *Porites branneri* Rathbun, Roos, Studies on the Fauna of Curaçao and other Caribbean Islands, vol. 20, No. 81, p. 47.
1966. *Porites branneri* Rathbun, Rigby and McIntire, Brigham Young Univ., Geol. Studies, vol. 13, pp. 29, 30, 33, 37, 38, 41.

The two specimens referred to *Porites branneri* Rathbun are fragmentary and corroded. One of the specimens is a flattened irregular cylinder open at both ends and hollow nearly throughout, and the other (C575a) a nondescript doubled-over expanse, one face of which is illustrated under figure 4 on Plate 10. The corallum is unusually porous due to the weathering effect imposed on the naturally loose and open structure. The calices are crowded, small, and shallow, polygonal in outline, and separated by a thin fenestrated wall. There are 12 granulate septa and three to six papillose pali, the pali occurring before the main septa. In a number of calices the columellar area is ringlike with a small pit in the center. Other morphologic details can not be made out because of poor preservation.

Measurements. — Specimen C575a: Corallum fragment, height 12.5 mm, width 20.2 mm; diameter of calices 0.79 mm to 1.43 mm; thickness of corallum wall 2.5 mm to 3.0 mm.

Locality. — In wall of drainage ditch near south shore of Salina de Guaiguaza, 5.6 kilometers west of Puerto Cabello, State of Carabobo. Guaiguaza Clay. Upper Pliocene. Two fragments.

Comparisons. — The porous structure, the lacelike appearance of the surface, and the small hole in the center of the columellar process are the characters differentiating *P. branneri* from other species of the *Porites porites* complex.

Range and distribution. — This is the first report of *Porites branneri* as a fossil (late Pliocene). The species is known to be living, however, in Brazil (Parahyba do Norte, Candeias Reef off Pernambuco, Natal, and Maceio Reef off Alagoas), Curaçao (Caracas Bay), British Honduras (Pedro Bank), Mexico (Isla de Lobos), and the Bahamas.

Remarks. — As it is possible that *Porites branneri* Rathbun and *Porites porites* (Pallas) have been confused by some authors, there is listed below all of the references to *P. porites* that have come to my attention:

1758. *Corallium poris stellatus* Seba, Locupletissimi Rerum Naturalium Thesauri, vol. 3, p. 202, pl. 109, fig. 11.
1766. *Madrepora porites* (pars) Pallas, Elenchus Zoophytorum, p. 324.
1767. *Madrepora porites* (pars) Pallas, Linnaeus, Systema Naturae, ed. 12, pt. 2, p. 1279.
1786. *Madrepora porites* Pallas, Ellis and Solander, The Natural History of many curious and uncommon Zoophytes, p. 172, pl. 47, fig. 2.
1789. *Madrepora porites* (pars) Pallas, Esper, Die Pflanzenthier in Abbildung nach der Natur, vol. 1, pts. 3-4, pp. 135-139, pls. 21-21a.
1791. *Madrepora porites* (pars) Pallas, Gmelin, Systema Naturae, ed. 13, pt. 6, p. 3774.
1801. *Madrepora porites* Pallas, Lamarck, Syst. Anim. sans Vert., p. 371.
1807. *Porites polymorphus* (pars) Link, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, p. 163. [Fide Vaughan 1902b, p. 57.]
1816. *Porites clavaria* Lamarck, Hist. Nat. Anim. sans Vert., vol. 2, p. 270. [Fide Vaughan 1902b, p. 57.]
1820. *Madrepora porites* Pallas, Schweigger, Handbuch der Naturgeschichte, p. 413.
1853. *Madrepora porites* Pallas, Nelson, Geol. Soc. London, Quart. Jour., vol. 9, p. 211.
- 1888b. *Porites clavaria* Lamarck, Heilprin, Acad. Nat. Sci. Philadelphia, Proc., vol. 40, p. 306.
1895. *Porites clavaria* Lamarck, Gregory, Geol. Soc. London, Quart. Jour., vol. 51, p. 282. [Fide Vaughan, 1902a, p. 314.]
1901. *Porites polymorpha* Link, Verrill, Amer. Jour. Sci., ser. 4, vol. 13, p. 77.
- 1901b. *Porites polymorpha* Link, Verrill, Connecticut Acad. Arts Sci., Trans., vol. 11, pt. 1, art. 3, pp. 158-159, pl. 31, figs. 3-3a. [Fide Smith, 1948, p. 81.]
- 1901a. *Porites porites* (Pallas), Vaughan, R. Mus. Geol. Mineral. Leiden, Samml., vol. 2, pp. 8, 9, 10, 11, 12, 73-74.
- 1902b. *Porites porites* (Pallas), Spencer, Geol. Soc. London, Quart. Jour., vol. 58, p. 361.
- 1902a. *Porites porites* (Pallas), Vaughan, U.S. Fish Comm., Bull., vol. 20 for 1900, pp. 314-316, pl. 28.
- 1902a. *Porites porites* forma *clavaria* Lamarck, Vaughan, U.S. Fish Comm., Bull., vol. 20 for 1900, p. 316, pl. 29; pl. 31, fig. 2. [Fide Vaughan 1919a, p. 498.]
- 1902b. *Porites porites* (Pallas), Vaughan, Biol. Soc. Washington, Proc., vol. 15, pp. 56-58.
1906. *Porites porites* (Pallas), Bernard, Catalogue of the Madreporarian Corals in the British Museum (Natural History), vol. 6, pt. 2, pp. 11, 16, 31, 32, 43.
1909. *Porites porites* (Pallas) var. Vaughan, Carnegie Inst. Washington, Yearbook No. 7, p. 135.
1909. *Porites porites* (Pallas) forma *clavaria* Lamarck, Hartmeyer, Meereskunde Berlin, Jahrg. 3, No. 2, p. 9, pl. 1, fig. 4.
- 1912b. *Porites clavaria* Lamarck, Vaughan, Carnegie Inst. Washington, Yearbook No. 10, pp. 148, 152, 156, pl. 4, fig. c; pl. 6, figs. 3,4. [Fide Vaughan 1919, p. 498.]
1913. *Porites porites* (Lamarck), Brown and Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., vol. 65, p. 497.
- 1915d. *Porites clavaria* Lamarck, Vaughan, Washington Acad. Sci., Jour., vol. 5, p. 597. [Fide Vaughan 1919, p. 498.]
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- 1958b. *Porites porites* (Pallas), Squires, Amer. Mus. Nat. Hist., Bull., vol. 115, art. 4, p. 251.
- 1958a. *Porites porites* (Pallas), Zans, Geol. Sur. Dept. Jamaica, W.I., Bull. No. 3, p. 31.
- 1958b. *Porites porites* (Pallas), Zans, Geonotes, vol. 1, No. 2, p. 23.
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- 1959b. *Porites porites* (Pallas), Goreau, Ecology, vol. 40, pp. 70, 73, 74, 75, 76, 81, 85.
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- 1960a. *Porites porites* (Pallas), Lewis, Canadian Jour. Zool., vol. 38, No. 2, pp. 1134, 1135, 1136, 1137, 1138, 1139, 1140, 1144, pl. 3, fig. 6; pl. 4, fig. 9; pl. 7, fig. 14.
- 1960c. *Porites porites* (Pallas), Lewis, Barbados Mus. Nat. Hist. Soc., Jour., vol. 28, No. 1, p. 11.
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1966. *Porites porites* (Pallas), Stanley, Amer. Assoc. Petrol. Geol., Bull., vol. 50, No. 9, pp. 1931, 1938, pl. 1, fig. 6.
1966. *Porites porites* (Pallas), Rigby and McIntire, Brigham Young Univ., Geol. Studies, vol. 13, pp. 28, 30.
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The range of *Porites porites* (Pallas) is given by authors as Miocene to Recent. The Miocene occurrence is in the La Cruz Marl near Santiago, Cuba (Vaughan). In the Pleistocene, the species has been found in the Key Largo Limestone of Florida, in the Isthmus of Panama (Black Swamp, near Mt. Hope), and in low-level reefs of Curaçao and Barbados. The living *P. porites* is recorded from Bermuda, the Bahamas (Bimini), Florida (Spanish Harbor, Key Largo, the Tortugas), Mexico (Vera Cruz, Isla de Lobos, and Alacran Reef), British Honduras (Rendezvous Cay, Turneffe, Lighthouse Reef, Glover's Reef), Jamaica (Lime Cay, Rockham Cay, and Ocho Rios Reef where it occurs in the back reef, lagoon, reef crest, and seaward slope), Puerto Rico, Curaçao (Piscadera Baai, Spaansche Water, St. Michiels Baai, Kaap Malmeeuw, Awa di Oostpunt, and Caracas Bay), and Barbados (along the west coast).

A synonymy of *P. porites* (Pallas) by Coryell and Ohlsen (1929) includes the following: *P. polymorphus* Link, *P. clavaria* Lamarck, *P. flexuosa* Dana, *P. flabelliformis* Lesueur, *P. solanderi* Duchassaing and Michelotti, *P. plumieri* Duchassaing and Michelotti, *P. macrocephala* Duchassaing and Michelotti, *P. recta* Lesueur, *P. valida* Duchassaing and Michelotti, *P. nodifera* Klunzinger.

Diploria strigosa (Dana)

Pl. 6, figs. 3-5; Pl. 7, figs. 1-4

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Two bleached Recent fragments of this species were collected on the beach, three badly corroded and oxidized fragments were collected from the Abisinia Formation (Pleistocene), and one complete corallum was found loose on the surface of the Playa Grande formation (Pliocene). The best preserved specimen of the lot is the last-mentioned (N565a), and the corallum of that is a thick, rounded-oblong disk, gently and evenly convex in profile, and light brown in color. The upper and lower surfaces of the corallum are marked by sinuous, discontinuous, and occasionally elongated valleys that are generally interconnected but in some places closed off at one end by the colline. The valleys range from 3.5 mm to 9 mm in width, taking into consideration all of the specimens available and range from 4 mm to 5 mm in depth. The collines are worn down on most of the specimens, and are subacute to flattish, with a thickness of 1.5 to 2 mm. The septa are exsert, and as they are arched over the colline on one of the Recent specimens (A565a), it is inferred that this is their normal disposition on unweathered coralla. The number and arrangement of the septa are variable — 12 to 21 per centimeter, the highest number obtaining where there is a regular alternation of primary and secondary septa, the lowest where no secondary septa can be seen.

On specimen N565a there is an average of 16 septa to the centimeter, or 32 on both sides of the colline, and this indicates that there is not a full complement of secondary septa. The paliform lobes of the primary septa are well developed. The summit or inner margin of the primary septa is serrated by irregularly spaced pairs of short laterally directed spines (as many as ten pairs and as few as four), and the sides of the septa are studded with small scattered granulations. The columella consists of closely twisted trabeculae.

Measurements. — Specimen A565a: corallum fragment, length 25 mm, width 14 mm; collines narrowly grooved toward the edge of the corallum; width of valleys 3.5 mm to 5 mm, average depth of valleys 4 mm; septa per centimeter 21. Specimen A565b: corallum fragment, length 32 mm, width 24 mm; septa per centimeter 12-15. Specimen D565: average number of septa per centimeter 13. Specimen N565a: corallum length 120 mm, width 80 mm, thickness 30 mm; collines not grooved on superior surface, grooved in a number of places on the inferior surface; width of valleys 4.5 mm to 9 mm, average about 5.5 mm; depth of valleys 4 mm - 5 mm; average number of septa per centimeter 16.

Localities. — Recent, on beach at Playa Grande Yachting Club, Distrito Federal. Two fragments. Abisinia Formation, eastern edge of Playa Grande village at W-30. Three poorly preserved fragments. Playa Grande Formation (Catia Member) in the vicinity of W-21, north flank of Litoral anticline. One corallum.

Remarks. — Of the three well-known tropical American species of *Diplora* — *D. strigosa* (Dana), *D. labyrinthiformis* (Linnaeus), and *D. clivosa* (Ellis and Solander) — the Cabo Blanco forms, both Recent and fossil, seem closest to *D. strigosa*. The widespread *D. labyrinthiformis* is differentiated from *D. strigosa* by the prominent longitudinal depression along the colline, and *D. clivosa* is distinguished from *D. strigosa* by the large gibbosities of the corallum and by its relatively narrow valleys.

Remarks and distribution. — The finding of *D. strigosa* in the Cabo Blanco area extends the range of the species back to the Pliocene and adds a new Pleistocene and Recent locality.

Diplora strigosa (Dana) has hitherto been known from the Quaternary only. Pleistocene occurrences are in the Bahamas (Fresh Creek fossil reef); Florida (Key Largo Limestone); Costa

Rica (Monkey Point in slightly elevated reefs); Santo Domingo; St. Eustatius (White Wall); Curaçao (Westpunt); Aruba (Daimarie); Bonaire (Fontein); and Barbados. The living species has been reported from Bermuda; the Bahamas (2.5 fathoms and over off Rabbit Cay); south of the Louisiana coast (East Flower Garden Bank); Florida (Miami area and Tortugas); Mexico (Alacran and Blanquilla Reefs, Vera Cruz, Isla de Lobos); British Honduras (Rendezvous Cay, Turneffe, Lighthouse and Glover's Reefs, Pedro Bank); Cuba; Jamaica (shallow water); Haiti; Puerto Rico; Antigua; St. Thomas; Curaçao (Sta. Martha Baai, St. Michiels Baai, Caracas Bay, Spanish Water, Spanish Port); Venezuela (Puerto La Cruz); and Barbados.

***Manicina areolata puntagordensis*, new subspecies**

Pl. 4, fig. 5; Pl. 5, figs. 1-5; Pl. 12, fig. 4

The corallum is heavy, hemispherical, subovate in outline. The calicular or upper surface is convex and strongly ridged. The non-calicular or basal surface is flat and nearly entirely veneered by a thin epitheca of calcium carbonate in concentric rings, the epitheca encroaching locally on the sides of the corallum a short distance above the base. Near the center of the lower surface is a peduncular scar representing the vestige of a short stalk or attachment area. There are 12 or 13 nonperforate exsert septa to the centimeter, or 24 to 26 on both sides of the colline. Most or all of the septa meet at the columella which is relatively thin, continuous, compressed, more or less laminar, and elevated a millimeter or so above the trough of the valley floor. Intercalated between some of the primary septa is a thin secondary septum, and there are three or four of the latter per centimeter. All of the septa continue over the colline but only the principal ones abut against the columella where they are a little curved. The summit of the septa is marked by a row of paired pointed denticles directed laterally, and there are about 35 subequally spaced pairs on a septum 13 mm. in length from the columella to the edge of the colline. The sides of the septa are granulated by regular rows of small beads. The costae are about one millimeter apart. The valleys are wide and V-shaped, and the slopes are longer and straighter on one side, shorter and more sinuous on the other. The longer valleys tend to narrow on the lateral slope of

the corallum. The troughs of the valleys are accentuated by the thin, vertically projecting columellar walls which unite with the columellas of adjacent valleys to form sharply truncate and angular enclosures at their head. However, on the lower side of the corallum most of the valleys seem to be open-ended. The overall slope of the valleys ranges from an extreme of roughly 20 degrees on one slope to an extreme of about 60 degrees on the other. The colline is narrow and single a short distance above the base of the corallum, but as it continues to the top of the calicular surface it broadens markedly and becomes gently bipartite or grooved.

Measurements. — Holotype (S566a): Corallum length 119 mm, width 92 mm, thickness 63 mm; width of colline 1 mm (and ungrooved) on side near base increasing to 5 mm (and grooved) near end of ridge on top of calicular surface; width of valley near head 13 to 15 mm, near base of corallum 7 to 10 mm; average height of colline on top of corallum 11-12 mm; length of septa from columella to crest of colline 9 to 13 mm.

Locality. — North flank of Punta Gorda anticline at W-23 near *Lithothamnium* reef. One specimen, the holotype. Playa Grande Formation (Maiquetía Member).

Comparisons. — It should be noted, in reading the description and comparing the illustrations of the Venezuelan fossil under discussion, that the subdued septa, the V-shaped valleys, and the unequal smooth slopes of the valleys are due to corrosion, and that if well-preserved specimens were available these particular features would resemble those of *Manicina areolata* (Linnaeus), *Manicina gyrosa* (Ellis and Solander), and *Manicina mayori* Wells. (The last named — *M. mayori* — is now believed by Dr. Wells to be the same as *M. areolata* (Linnaeus) but much larger in size and somewhat different in shape). What does seem, however, to be an inherent character of the Venezuelan fossil is the elevated, solid, compressed, and continuous columella and the sharp angles made by convergent columellas at the heads of the valleys as contrasted with the lower, broader, and more trabecular columella and the more rounded valley-heads of the *M. areolata* complex. The new subspecies then differs from *M. areolata* in its prominent and more or less laminar columella.

The Venezuelan specimen resembles certain Recent specimens of *Mancina mayori* in the collections at Cornell University and the

United States National Museum, but is particularly close to the illustration by Matthai (1928, p. 94, pl. 63, fig. 6) of *Mancina gyrosa* (Ellis and Solander). The latter is Ehrenberg's worn example "(Reg. No. 2859), without locality." The difference is in the angulation of the convergent valley-heads which is not nearly so sharp as on the Venezuelan form, nor is the columella as salient and as solid as on the Venezuelan form.

As *Manicina mayori* is now believed to be the same as *M. areolata*, as some authors would place *M. mayori* in synonymy with *M. gyrosa*, and as *M. areolata* is the oldest name of the complex, the new subspecific name of *puntagordensis* is applied to *Manicina areolata*.

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Manicina arcolata (Linnaeus) is reported to range from Miocene to Recent. The Miocene occurrence is in the Nivajé Shale of the Dominican Republic. In the Pliocene the species has been recorded from the Caloosahatchee River, Florida. Pleistocene localities are in Costa Rica (Monkey Point and Limon), the Panama Canal Zone (in the oyster shell layers of Black Swamp, near Mt. Hope), the Dominican Republic, Guadeloupe, St. Bartholomew, St. Eustatius (Sugar Loaf), St. Kitts (Brimstone Hill), and Barbados. The living form is found, generally in shallow water, from the Bahamas to Barbados, including Florida and the Tortugas; Mexico (Alacran Reef); British Honduras (Rendezvous Cay, Lighthouse Reef, Pedro Bank); Panama; Colombia: Cuba; Jamaica (Bluefields Bay, Ocho Rios Reef); Dominican Republic; Puerto Rico (Ensenada Honda, Mayaguez, Aguadilla, Cayo Icacos); Antigua; St. Thomas (Sail Rock 20-23 fathoms); Grenada; Curaçao (Spanish Water); and Venezuela. The species has also been reported from the Cape of Good Hope (Simmon's Bay) by Quelch, 1866, p. 91.

***Solenastrea hyades* (Dana)**

Pl. 8, figs. 4-8; Pl. 9, figs. 1-4

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The fossil corallum occurs as a thick irregular discoidal incrustation, or is hemispherical to spheroidal, or is an elongated dome, the last probably having been a projecting lobe which was broken off from a much larger compact mass. Several of the specimens bear irregular bumps or gibbosities on the surface, but on some of the fragments the surface is uniform. The calices are subcircular to sub-oval, but polygonal where crowded, with diameters ranging from a little less than 2 mm to 4.5 mm, the average being a little over 3 mm. Most of the calices touch each other, but on specimen J567 they are separated by 1 to 2 mm, and on specimen C570a by 2 to 4 mm. The margin of the calices is slightly elevated and regularly beaded, the beading caused by the thickening of each septum at the margin. Where there is a space between the calices, low ridges

arising at the beaded margin extend part way across the coenosteum, and the spaces are somewhat blistered in appearance. The calices are shallowly and regularly concave, with a depth of a millimeter or so. In mature calices there are some 24 thin imperforate septa, 12 of them, or those of the first two cycles extending to the columella, the 12 tertiaries depressed a little and extending about halfway toward the columella. Most of the Tertiary septa are curved toward, and fused with, the septa of the second cycle at about the mid-point of their length. All of the septa are minutely serrulate on the summit, with about 10 pairs of irregularly spaced denticles directed laterally on a primary septum 1 mm in length. The septal faces are granulated, and the paliform lobes are small. The costae are thin and closely spaced, with the summit margin serrulated locally and with widely spaced lamellar dissepiments. The exotheca is vesicular. The columella is small and consists of twisted septal processes.

Measurements. — Specimen J568a: corallum hemispherical, length 79 mm, width 68 mm, height 60 mm; calices 2 to 4.5 mm in diameter. Specimen I568: corallum elongate-domal, basal diameter 26 mm, height 28 mm; calices 3 to 3.5 mm in diameter. Specimen H568: corallum discoidal, length 55 mm, width 46 mm, thickness (excluding gibbosity) 27 mm; calices 3 to 4.5 mm in diameter. Specimen C570a: corallum fragment, length 35 mm, width 28 mm, thickness 14.5 mm; diameter of calices 1.8 to 2.9 mm.

Localities. — Hillside above west bank of Quebrada Mare Abajo at W-13. Lower Mare Formation. Four incomplete specimens. Small stream 100 meters west of Quebrada Mare Abajo. Lower Mare Formation. One corallum, nearly whole. South flank of Punta Gorda anticline at W-25. Mare Formation. Two specimens. Drainage ditch about one meter deep near south shore of La Salina de Guaiguaza, 5.6 kilometers west of Puerto Cabello, State of Carabobo. Eight specimens. Guaiguaza Clay.

Comparisons. — *Solenastrea hyades* (Dana) and *Solenastrea bournoni* Edwards and Haime are closely related. According to Vaughan (1919a, p. 401) and to Smith (1948, pp. 88, 89) the calices of *S. hyades* are consistently larger (3 mm to 3.5 mm) than those of *S. bournoni* (2 mm to 2.5 mm) and, perhaps more significant, the tertiary septa of *S. hyades* are generally curved toward, and fused with, the sides of the secondaries, whereas on *S. bournoni* the tertiary

septa are generally relatively straight and their inner margins free.

Range and distribution.—The range of *Solenastrea hyades* is middle Miocene to Recent. The Miocene occurrences are in the Gurabo Formation of the Dominican Republic, in the La Cruz Marl of Cuba, and at Cienaga near Habana, Cuba. In the Pliocene the species is found in the Caloosahatchee Marl of Florida, and in the Mare Formation and Guaiguaza Clay of Venezuela (this report). In the Pleistocene *S. hyades* has been reported from Florida and from the Island of Montserrat. The species is living in the Bahamas; in Florida (Key West, near Miami, at Caesar's Creek and near Osprey, Cedar Keys); in Cuba; and in Jamaica.

Solenastrea cf. *S. bournoni* Edwards and Haime Pl. 12, figs. 1-3

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The corallum is hemispherical and tumid, with a large irregular area of attachment below, and a gibbous calicular surface above. The calices are subcircular to subovate, and subequal to unequal in size. Most of the calices are separated by varying distances up to 2.5 mm, but a few of them touch each other. The margins of the calices are somewhat elevated and beaded, the beading produced by the thickening of the septa at the margin and by the abutment there with the costae of the coenosteum. The calices are shallowly and regularly concave (about a millimeter in depth), with steep inner sides and a flattish columellar area. The coenosteum between the calices is corroded, but in less weathered areas it is seen to be minutely granulated. The costae around the margins of the calices are also covered by minute granules. The costae are moderately prominent, are separated by linear grooves, and extend down the calice on to the intercalicular space part way between the cups. There are 30 to 32 septa on the average, though as few as 22 and as many as 37 have been counted. Generally the number of septa depends on the size and maturity of the calice. The septa occur in three cycles. The primary and secondary ones are thicker at the margin of the calice than inward and extend to the columella. Rarely, however, a secondary septum joins a primary one close to the columella. The tertiary septa are much thinner and more depressed than the others and do not reach the columella. Nearly all of the tertiaries have free inner margins, but here and there a tertiary septum joins a secondary septum. All of the septa are serrulate at the summit. The septal faces are granulose, the granulations small, pointed, and imperforate. The pali before the main septa are small and irregularly papillose. The columella is small.

Measurements. — Specimen H570a: corallum length 27 mm, width 21 mm, height 19 mm; the maximum diameter of the calices ranges from 2.6 mm to 3.9 mm.

Locality. — South flank of Punta Gorda anticline, at W-25. Mare Formation. One specimen.

Comparisons. — The Venezuelan fossil closely resembles the Recent form of *Solenastrea bournoni* Edwards and Haime, differing from that, however, by the greater number of septa (30-32 compared with an average of about 24 in *S. bournoni*), by the larger calices (2.6 mm to 3.9 mm compared with 2.0 mm to 2.5 mm), and in the absence of blisters in the space between the calices. If the average size of the calices and the number of septa are variable characters in Recent specimens of *S. bournoni* from different localities (I have counted, for example, as many as 40 septa in large calices on a corallum from Bluefields Bay, Jamaica, where most of the calices bear about 24 septa), then the slightly larger calices and larger number of septa on the Venezuelan fossil suggest that it is a variant of *S. bournoni* rather than a distinct species. As for the blisters on the coenosteum, these may or may not be present on the typical *S. bournoni*, so that their absence on the single Venezuelan specimen may well be fortuitous or due to corrosion.

The separation of *S. hyades* and *S. bournoni* into two species has yet to be established, but the fact that most of the tertiary septa are free rather than fused persuades me to relate the Venezuelan form to *S. bournoni*.

Range and distribution. — The range of *Solenastrea bournoni* Edwards and Haime is Miocene to Recent. Miocene occurrences are in the Dominican Republic (Zone H, Río Cana) and Cuba (La Cruz Marl). In the Pliocene the species has been reported from Shell Creek and the Caloosahatchee Marl of Florida. In the Pleistocene it is recorded from the Dominican Republic. The living *S. bournoni* is found in the Bahamas; in Florida (the Tortugas 8-9 fathoms); British Honduras (Rendezvous Cay); Cuba; Jamaica; Puerto Rico (Caballo Ahogado, 5 feet, and Bahía de Boquerón, 4 feet); the Virgin Islands; and Curaçao (Piscadera Baai, Sta. Martha Baai, 10-45 meters).

Oculina diffusa Lamarek

Pl. 8, figs. 1-3

1816. *Oculina diffusa* Lamarek, Hist. nat. Anim. sans Vert., vol. 2, p. 285.

1825. *Oculina diffusa* Lamarck, Blainville, Dictionnaire des Sciences Naturelles, vol. 35, p. 354.
1827. *Oculina diffusa* Lamarck, Deslongchamps, Encyclopédie Méthodique, Zoophytes, pt. 2, p. 575.
1836. *Oculina diffusa* Lamarck, Lamarck, Hist. nat. Anim. sans Vert., ed. 2, vol. 2, p. 456.
1846. *Oculina diffusa* Lamarck, Dana, U.S. Exploring Exped., vol. 7, Zoophytes, pp. 397, 398.
1850. *Oculina diffusa* Lamarck, Edwards and Haime, Ann. Sci. Nat., sér. 3, vol. 13, p. 68.
1850. *Oculina diffusa* Lamarck, Duchassaing, Animaux Radiaires des Antilles, p. 15.
1857. *Oculina diffusa* Lamarck, Edwards and Haime, Histoire naturelle des Coralliaires, vol. 2, p. 107.
1859. *Oculina diffusa* Lamarck, Dana, Synopsis Rept. Zoophytes U.S. Exploring Exped., p. 67.
1861. *Oculina diffusa* Lamarck, Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., ser. 2, vol. 19, p. 338.
1866. *Oculina diffusa* Lamarck, Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., ser. 2, vol. 23, p. 162.
1870. *Oculina diffusa* Lamarck, Duchassaing, Revue des Zoophytes et des Spongiaires des Antilles, p. 25.
1871. *Oculina diffusa* Lamarck, Pourtalès, Mus. Comp. Zool., Mem., vol. 2, No. 4, pp. 23, 65.
- 1877c. *Oculina diffusa* Lamarck, Arango y Molina, R. Acad. Cienc. Méd., Fís. y Nat. Habana, An., vol. 14, p. 274.
1879. *Oculina diffusa* Lamarck, Dana, Corals and Coral Islands, ed. 2, p. 384.
1880. *Oculina diffusa* Lamarck, Pourtalès, in Agassiz, Mus. Comp. Zool., Mem., vol. 7, No. 1, pl. 3, figs. 10-12.
- 1881a. *Oculina diffusa* Lamarck, Studer, Naturforsch. Gesell. Bern, Mitth., Abhandl. 1880, p. 10, text-fig. 3.
1886. *Oculina diffusa* Lamarck, Quelch, Voyage H.M.S. Challenger, Rept. Sci. Results, Zoology, vol. 16, pt. 46, pp. 10, 11, 47, 49.
1888. *Oculina diffusa* Lamarck, Ortmann, Zool. Jahrb., Syst., vol. 3, p. 162.
- 1888b. *Oculina diffusa* Lamarck, Heilprin, Acad. Nat. Sci. Philadelphia, Proc., vol. 40, p. 304.
1899. *Oculina diffusa* Lamarck, Duerden, Inst. Jamaica, Jour., vol. 2, No. 6, p. 621.
- 1900a. *Oculina diffusa* Lamarck, Vaughan, U.S. Geol. Sur., Mon. 39, pp. 49, 116, 117, 212, pl. 2, fig. 5.
- 1901b. *Oculina diffusa* Lamarck, Verrill, Connecticut Acad. Arts Sci., Trans., vol. 11, pt. 1, art. 3, p. 175.
- 1902a. *Oculina diffusa* Lamarck ? var. Vaughan, U.S. Fish Comm., Bull., vol. 20 for 1900, pt. 2, pp. 291, 294, pl. 1, figs. 5-5a. [Fide Verrill, 1901b, p. 175.]
- 1902d. *Oculina diffusa* Lamarck, Duerden, Nat. Acad. Sci. Washington, Mem., vol. 8, pp. 585-588, pl. 22, fig. 149.
1903. *Oculina diffusa* Lamarck, Verrill, Connecticut Acad. Arts Sci., Trans., vol. 11, pt. 2, art. 10, p. 848.
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1913. *Oculina diffusa* Lamarck, Mayer, Carnegie Inst. Washington, Yearbook No. 11, p. 126.
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- 1915b. *Oculina diffusa* Lamarck, Vaughan, Carnegie Inst. Washington, Yearbook No. 13, pp. 224, 225.

- 1915d. *Oculina diffusa* Lamarck, Vaughan, Washington Acad. Sci., Jour., vol 5, No. 17, p. 596.
- 1916a. *Oculina diffusa* Lamarck, Vaughan, Carnegie Inst. Washington, Yearbook No. 14, p. 227.
- 1918b. *Oculina diffusa* Lamarck, Vaughan, Carnegie Inst. Washington, Publ. No. 231, Papers Dept. Marine Biol., vol. 9, p. 326.
- 1919a. *Oculina diffusa* Lamarck, Vaughan, U.S. Nat. Mus., Bull. 103, No. 9, p. 352.
1929. *Oculina diffusa* Lamarck, Felix, Fossilium Catalogus. I: Animalia, par. 44, pp. 596-597.
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1943. *Oculina diffusa* Lamarck, Smith, Florida Acad. Sci., Proc., vol. 6, No. 1, pp. 44, 46.
1943. *Oculina diffusa* Lamarck, Vaughan and Wells, Geol. Soc. Amer., Spec. Paper, No. 44, pp. 180, 181, 325, pl. 33, fig. 2.
1944. *Oculina diffusa* Lamarck, Wells, Jour. Paleont., vol. 18, No. 5, p. 446.
1948. *Oculina diffusa* Lamarck, Smith, Atlantic Reef Corals, pp. 62, 66, 91, pl. 28.
1954. *Oculina diffusa* Lamarck, Smith, U.S. Fish and Wildlife Serv., Fish. Bull., vol. 55, No. 89, p. 293.
1954. *Oculina diffusa* Lamarck, Fontaine, Inst. Jamaica, Ann. Rept. 1953-1954, p. 25.
- 1956a. *Oculina (Oculina) diffusa* Lamarck, Wells, Treatise on Invertebrate Paleontology, Pt. F, Coelenterata, p. F140, fig. 308, 4.
1956. *Oculina diffusa* Lamarck, Menzel, Oceanogr. Inst. Florida State Univ., Contrib. No. 61, p. 3.
- 1958b. *Oculina diffusa* Lamarck, Squires, Amer. Mus. Nat. Hist., Bull., vol. 115, art. 4, pp. 229, 232, 238, 256-257, pl. 38, fig. 4.
- 1958a. *Oculina diffusa* Lamarck, Zans, Geol. Sur. Dept. Jamaica, W.I., Bull. No. 3, p. 32.
- 1959a. *Oculina diffusa* Lamarck, Goreau, Biol. Bull., vol. 116, No. 1, pp. 59, 64, 66, 67.
- 1959b. *Oculina diffusa* Lamarck, Goreau, Ecology, vol. 40, No. 1, pp. 70, 75, 81, 85.
1959. *Oculina diffusa* Lamarck, Zans, Geonotes, vol. 2, No. 1, pp. 29, 35.
- 1960b. *Oculina diffusa* Lamarck, Lewis, Canadian Jour. Zool., vol. 38, No. 6, p. 1135.
- 1961a. *Oculina diffusa* Lamarck, Goreau, Endeavour, vol. 20, fig. 5.
1961. *Oculina diffusa* Lamarck, Duarte Bello, Acuario Nac. [Cuba], Ser. Educac. No. 2, pp. 9, 60-61, figs. 49, 50.
1962. *Oculina diffusa* Lamarck, Stoddart, Atoll Research Bull., No. 87, pp. 19, 20.
1963. *Oculina diffusa* Lamarck, Almy and Carrión-Torres, Caribbean Jour. Sci., vol. 3, Nos. 2-3, pp. 143, 156, 162, pl. 16a.
1963. *Oculina diffusa* Lamarck, Jones, Bull. Marine Sci. Gulf and Caribbean, vol. 13, No. 2, p. 284.
1964. *Oculina diffusa* Lamarck, Roos, Studies of the Fauna of Curaçao and other Caribbean Islands, vol. 20, No. 81, p. 48.
1964. *Oculina diffusa* Lamarck, Rivero, Geos, No. 11, pp. 112, 113.
1965. *Oculina diffusa* Lamarck, Neumann, Bull. Marine Sci., vol. 15, No. 4, p. 1004.
1967. *Oculina diffusa* Lamarck, Mesolella, Science, vol. 156, No. 3775, p. 639.

The corallum is a small somewhat irregular cylindrical branch with a subcircular cross section. The surface of the corallum is worn and smoothish, but in some places the original fine granulation has been preserved. The calices are small, more or less circular, rather distant from one another, somewhat elevated, and thickened at the rounded margin. The markings on the calices have been mostly obliterated but just off one of them the coenosteum is both costate and granulate, the costae low and faint, the granulations consisting of low pointed processes. There are about 24 septa arranged in three cycles, those of the first two cycles subequal and reaching the columella, the ones of the third cycle the smallest and extending part way to the columella. All of the septa are a little exsert, and all of them are minutely beaded on the summit and sides. The pali before the larger septa are weathered, and the columella is seemingly somewhat papilliform.

Measurements. — Specimen D577a: corallum fragment, length 12 mm, maximum diameter about 5 mm; average diameters of calice 2.0×2.2 mm measured between the inner margins; distance between calices 2.5 mm to 4 mm.

Locality. — Eastern edge of Playa Grande village at W-30. Abisinia Formation (Pleistocene). One specimen.

Remarks. — Though the only specimen is badly weathered, the characters that can be discerned are much like those of *Oculina diffusa* Lamarck, a Mio-Pliocene to Recent species of the Western Atlantic and circum-Caribbean region.

Range and distribution. — Mio-Pliocene (Cubagua Island, Venezuela) to Recent. Pleistocene localities, in addition to the present one from the Abisinia Formation of Venezuela, are Bimini in the Bahamas, Mount Hope in the Panama Canal Zone, and on Barbados. The living *O. diffusa* has been reported from Bermuda, the Bahamas, Florida (off Miami, in the Tortugas to 15 fathoms, and St. George's Sound), Mexico (off Vera Cruz), British Honduras (Pedro Bank), Panama, Cuba, Jamaica, Puerto Rico (10-16 fathoms), St. Thomas, Martinique, and probably at Puerto La Cruz, Venezuela.

Oculina sp. cf. **O. valenciennesi** Edwards and Haime

Pl. 6, figs. 1, 2

1850. *Oculina Valenciennesi* Edwards and Haime, Ann. Sci. Nat., sér. 3, vol. 13, p. 69.

1957. ? *Oculina Banksi* Edwards and Haime, *Historie naturelle des Coralliaires*, vol. 2, p. 107. [Fide Verrill, 1901b, p. 176.]
1857. *Oculina Valenciennesi* Edwards and Haime, *Historie naturelle des Coralliaires*, vol. 2, p. 108.
1866. ? *Oculina bermudiana* Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., ser. 2, vol. 23, p. 162, pl. 9, figs. 1, 2. [Fide Verrill, 1901b, p. 176.]
1886. *Oculina valenciennesi* Milne-Edwards and Haime, Quelch, Voyage of H.M.S. Challenger, Rept. Sci. Results, Zoology, vol. 16, pt. 46, pp. 11, 50.
1886. *Oculina bermudensis* Duchassaing and Michelotti, Quelch, Voyage of H.M.S. Challenger, Rept. Sci. Results, Zoology, vol. 16, pt. 46, pp. 9, 10, 51-52. [Fide Verrill, 1901b, 176.]
- 1901b. *Oculina Valenciennesi* Edwards and Haime, Verrill, Connecticut Acad. Arts Sci., Trans., vol. 11, pt. 1, art. 3, p. 176, pl. 32, fig. 5.
1944. *Oculina valenciennesi* Milne-Edwards and Haime, Wells, Jour. Paleont., vol. 18, No. 5, p. 446.
1948. *Oculina valenciennesi* Edwards and Haime, Smith, Atlantic Reef Corals, pp. 62, 67, 91-92.
1954. *Oculina valenciennesi* Edwards and Haime, Fontaine, Inst. Jamaica, Ann. Rept. 1953-1954, p. 25.
1954. *Oculina valenciennesi* Edwards and Haime, Smith, U.S. Fish Wildlife Serv., Fish. Bull., vol. 55, No. 89, p. 293.
1959. *Oculina valenciennesi* Milne Edwards and Haime, Zans, Geonotes, vol. 2, No. 1, pp. 29, 35.
- 1959b. *Oculina valenciennesi* Edwards and Haime, Goreau, Ecology, vol. 40, No. 1, pp. 70, 75, 85.
1961. *Oculina valenciennesi* Edwards and Haime, Duarte Bello, Acuario Nac. [Cuba], Ser. Educac. No. 2, pp. 9, 62.
1964. *Oculina valenciennesi* Edwards and Haime, Roos, Studies of the Fauna of Curaçao and other Caribbean Islands, vol. 20, No. 81, p. 48.

The corallum is a thin flattish fragment encrusted on a thin plate of fibrous aragonite. Judging from its appearance the fragment is part of the basal frond of the corallum from which the branches arise. The calices are relatively small, suboval in outline, unequally distant (1 mm to 3 mm) from one another, and separated by well-defined valleys. Through weathering the calices have been worn down and are now shallow and low but elevated asymmetricaly, with a maximum height of 1.7 mm, and with the slope on one side longer and less steep than on the other. The slopes are slightly convex or straight or a little concave in profile and everywhere are steep to nearly perpendicular. The margin of the calices is thin and sharp and unlike the rounded margin on the calices of the *O. diffusa*—*O. valenciennesi* complex. However, the sharp rim of the Venezuelan fossil may have been produced by the wearing down of the upper part of the calice to its present form. There are 32 to perhaps 42 septa depending on the size of the calice, the septa moderately thin except at the margin, the summits descending gently toward

the columella. The summit of the septa is dentate, with as many as 15 short blunt denticles on the longest septum 2.4 mm in length. The primary and secondary septa are nearly the same length and converge at the columella where they may be curved. The tertiary septa are short and straight, dentate at the summit, and acutely narrowed at the end. The sides of the septa are closely granulated, some of the granulations blunt but others pointed. The pali, which are present before the primary and secondary septa, cannot be differentiated from them. The columella is located off center within the calice, and although its structure can not be clearly discerned it seems to be papilliform. The external wall of the calices and much of the coenosteum are marked by prominent costae which are low, relatively broad, a little convex, and separated by narrow shallow grooves. Each costa, or in some places a pair of costae, joins the septum at the margin of the calice and continues down the slope into the valley floor where the costae abut against, or are curved and become confluent with, the costae of neighboring calices. The costae are minutely beaded as is the coenosteum in local areas not traversed by the costae.

Measurements. — Specimen I571a: corallum length 14 mm, width 13 mm, thickness 2.2 mm; average diameter of calices 3.5 mm $\times$ 3.0 mm; maximum elevation of calice 1.7 mm; longest septum 2.4 mm; thickness of aragonite substrate 1.6 mm.

Locality. — Lower Mare Formation at W-13 on hillside above west bank of Quebrada Mare Abajo. One specimen. Lower Pliocene.

Comparisons. — If the thin and sharp calicular margin of the Venezuelan specimen has been caused by the weathering down of the calice, and if the margin normally is a rounded one, the identity with *Oculina valenciennesi* Edwards and Haime is suggested. I have compared the base of *O. diffusa* Lamarek with that of *O. valenciennesi* on a number of specimens from different localities in the Recent collection of the U. S. National Museum and have observed that the calices of *O. diffusa* bear about 24 septa and those of *O. valenciennesi* an average of 32 septa (within a range of 28 to 42). Thus in the number of septa the Venezuelan form is closer to *O. valenciennesi* than to *O. diffusa*. On both of the last two species, however, the calices are farther apart, more circular, and more regularly elevated than on the Venezuelan specimen, and the columella centrally placed

rather than excentric. Whether these differences are due to individual variation rather than to inherent genetic character remains to be determined.

The sole Venezuelan fragment also resembles the sole fragment of *Oculina gatunensis* Toula (1911b, p. 489, pl. XXX (1), fig. 1) from the middle-upper Miocene Gatun Formation of the Panama Canal Zone. Toula's description and illustration are inadequate for definitive comparison but so far as can be determined *O. gatunensis* has circular calices, a rounded calicular margin, about 24 septa, and a costate coenosteum. According to Toula the Gatun specimen was compared with the Recent *O. diffusa* from Bermuda by Marenzeller who was of the opinion that the Canal Zone fragment was thicker and flatter and that the septa were less exsert than on *O. diffusa*.

The following Recent species of *Oculina* have been named by various authors as occurring in the circum-Caribbean region: *O. arbuscula* Agassiz, *O. banksi* Edwards and Haime, *O. bermudiana* Duchassaing and Michelotti, *O. coronalis* Quelch, *O. diffusa* Lamarck, *O. implicata* Agassiz, *O. oculata* Dana, *O. pallens* Ehrenberg, *O. petiveri* Edwards and Haime, *O. recta* Quelch, *O. robusta* Pourtales, *O. speciosa* Edwards and Haime, *O. valenciennesi* Edwards and Haime, *O. varicosa* Lesueur, *O. varicosa conigera* Verrill, and *O. virginea* (Linnaeus). A number of these have been synonymized with *O. diffusa* Lamarck, *O. valenciennesi* Edwards and Haime, or *O. varicosa* Lesueur, and Wells (1944, p. 446) has stated "At least 9 other 'species' of *Oculina* have been named from Western Atlantic and West Indian areas, most of these probably being merely ecologic variants of *O. diffusa*."

Range and distribution.—Should the identity of the Venezuelan fossil eventually be determined as *Oculina valenciennesi* Edwards and Haime, the present report will be the first concerning its occurrence in the Pliocene. Heretofore *O. valenciennesi* has been known only as a Recent form living in Bermuda (Harrington Sound 1-8 fathoms), the Bahamas, Cuba, Jamaica, and Venezuela (Puerto La Cruz).

Phyllangia americana Edwards and Haime Pl. 10, fig. 3; Pl. 11, fig. 1

1849. *Phyllangia americana* Edwards and Haime, Ann. Sci. Nat., sér. 3, vol. 12, p. 182.

1857. *Phyllangia americana* Edwards and Haime, Edwards and Haime, Histoire naturelle des Coralliaires, p. 616.

1859. *Synedras Gouldii* Lyman, Boston Soc. Nat. Hist., Proc., vol. 6, p. 274. [Fide Pourtalès, 1871, p. 30.]
1861. *Phyllangia americana* Milne-Edwards and Haime, Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., ser. 2, vol. 19, p. 356.
1861. *Stellangia reptans* ? Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., ser. 2, vol. 19, p. 80, pl. 10, figs. 1-2. [Fide Pourtalès, 1871, p. 30.]
1866. *Phyllangia americana* Milne Edwards and Haime, Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., ser. 2, vol. 23, p. 186.
1866. *Stellangia reptans* Duchassaing and Michelotti, Duchassaing and Michelotti, R. Accad. Sci. Torino, Mem., ser. 2, vol. 23, p. 186.
1870. *Phyllangia americana* Edwards and Haime, Duchassaing, Revue des Zoophytes et des Spongiaires des Antilles, p. 31.
1871. *Phyllangia americana* Milne-Edwards and Haime, Pourtalès, Mus. Comp. Zool., Mem., vol. 2, No. 4, p. 30.
- 1901c. *Phyllangia americana* Edwards and Haime, Verrill, Connecticut Acad. Arts Sci., Trans., vol. 11, pt. 1, art. 4, p. 194.
- 1902a. *Phyllangia americana* Milne-Edwards and Haime, Vaughan, U.S. Fish Comm., Bull., vol. 20 for 1900, pt. 2, p. 289.
- 1902d. *Phyllangia americana* Milne Edwards and Haime, Duerden, Nat. Acad. Sci. Washington, Mem., vol. 8, pp. 555-558, pl. 5, fig. 46.
1904. *Phyllangia americana* Milne Edwards and Haime, Greely in Branner, Mus. Comp. Zool., Bull., vol. 44, p. 266.
- 1904b. *Phyllangia americana* Edwards and Haime, Duerden, Carnegie Inst. Washington, Publ. No. 20, p. 85.
- 1906b. *Phyllangia americana* Edwards and Haime, Vaughan, U.S. Nat. Mus., Proc., vol. 30, No. 1477, p. 848.
- 1919a. *Phyllangia americana* Edwards and Haime, Vaughan, U.S. Nat. Mus., Bull. 103, No. 9, p. 409.
- 1927b. *Phyllangia americana* Milne Edwards and Haime, van der Horst, Bijdr. Dierk. Amsterdam. vol. 25, p. 159.
1943. *Phyllangia americana* Milne Edwards and Haime, Vaughan and Wells, Geol. Soc. Amer., Spec. Papers, No. 44, p. 178.
1947. *Phyllangia americana* Edwards and Haime, Wells, Bull. Amer. Paleont., vol. 31, No. 123, p. 169, pl. 11, fig. 6.
1954. *Phyllangia americana* Edwards and Haime, Fontaine, Inst. Jamaica, Ann. Rept. 1953-1954, p. 25.
- 1956a. *Phyllangia americana* Milne-Edwards and Haime, Wells, Treatise on Invertebrate Paleontology, Pt. F, Coelenterata, p. F409, fig. 307, 5.
1956. *Phyllangia americana* Milne-Edwards and Haime, Menzel, Oceanogr. Inst. Florida State Univ., Contrib., No. 61, p. 3.
1959. *Phyllangia americana* Milne Edwards and Haime, Zans, Geonotes, vol. 2, No. 1, pp. 29, 35.
1963. *Phyllangia americana* Milne-Edwards and Haime, Almy and Carrión-Torres, Caribbean Jour. Sci., vol. 3, Nos. 2, 3, pp. 143, 156, pl. 15b.
1964. *Phyllangia americana* Edwards and Haime, Roos, Studies on the Fauna of Curaçao and other Caribbean Islands, vol. 20, No. 81, p. 48.

The following description pertains to a clump of corallites whose calices have been worn down nearly to their base.

The corallum is encrusting and imbedded, forming a clump of low, subplocoid corallites, their free portions subcylindrical, a little divergent, and somewhat raised. The calices are relatively large, moderately deep, more or less oval in outline, and faintly costate.

The margins of the calices are irregularly distant, some nearly touching, others more removed. The walls are thin at the calicular edge. The walls, as well as the surface of the coenosteum, where unweathered are both costate and finely granulate, the costae slightly crested, each costa joining a septum at the margin of the calice. Within the largest calice there are about 32 septa in three cycles. The septa of the first two cycles are exsert, rather sturdy, about the same in length, and extend to the columella; the septa of the third cycle are short, depressed, and thin. The summit of most of the larger septa is dentate, with about 20 short denticles in a septum 4.3 mm in length. Both sides of the septa are granulose, the denticles short, stubby and pointed, with a number of them perforated at the projecting end. The columella is feeble and trabecular.

Measurements. — Specimen S688a: length of colony 29 mm, width 20 mm, maximum thickness 4.5 mm; diameters of largest calice 10.33 mm, width 6.4 mm; height of corallite above coenosteum 1.5-2.0 mm; longest septum 4.3 mm; maximum distance between margins of calices 2.0 mm; maximum depth of calice 3.5 mm.

Locality. — Near *Lithothamnium* reef at W-23, north flank of Punta Gorda anticline. Playa Grande Formation (Maiquetía Member). One specimen imbedded in the oyster *Ostrea (Alectryonia) caboblanquensis* Weisbord (1964, pp. 190-192, pl. 25, figs. 1-6). Lower Pliocene.

Remarks. — The description and illustration of this specimen pertain to a cluster of corallites whose calices have been so worn down below the original calicular margin that the fourth cycle of septa can no longer be seen. The maximum development of the septa and the full expression of other characters occur in the upper part of the calice. Thus the calices of unweathered Recent specimens of *P. americana* bear as many of 50 to 62 septa whereas there are only 32 or so near the bottom of the calice on the Venezuelan fossil. Also the first cycle septa of the complete *P. americana* are by far the most prominent of all of the septa, and although this particular character can be spotted at once on the living form it is not so apparent on the Venezuelan fossil specimen. Nevertheless, when Dr. Wells examined the specimen, he unhesitatingly identified it as *Phyllangia americana* Edwards and Haime.

Range and distribution. — Other than its occurrence in the

lower Pliocene of Venezuela (this report), *Phyllangia americana* is recorded only as a Recent species. The localities are the Bahamas (off Elbow Key 315 fathoms); west Florida (St. George's Sound); Jamaica; Martinique; St. Thomas; and Brazil (Bahía, São Sebastião, Caravellas). The living *P. americana* lives in relatively shallow water, despite its having been found at a depth of 315 fathoms off Elbow Key. According to Pourtalès (1871, p. 30) who identified *P. americana* from off Elbow Key "Dead specimens, rather worn, were dredged up with quite a number of other dead corals at this place, shoal-water and deep-water species being mixed together. The locality is very near the edge of the Salt Key Bank, at the foot of a very steep submarine slope, and washed by the edge of the Gulf Stream."

Paracyathus defilippii Duchassaing and Michelotti Pl. 10, figs. 1,2

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The corallite is solitary, attached at the base, relatively short, subtympanoidal or subcylindrical in shape, and costulate from calicular margin to base. The base is a little broader than the middle of the stem which is slightly contracted, but at the calice the corallite is again expanded to nearly the same diameter as the base. Just below the calicular margin and to one side of the corallite there is a secondarily thickened and nodulous area of regrowth. The costae are low but pronounced, subequal in size, a little wider than, to about as wide as, their interspaces, and, where not worn, narrowed somewhat at the crest. The costae of the outer wall are minutely granulated, the tubercles imperforate and disposed in two columns, each column close to but slightly off the crest of the costa. Below the outermost layer of the corallite the tubercles on the costae are perforate. Each costa joins each septum at the margin of the calice. The calice is regularly oval, the width nine-tenths the length. Within the calice of the only specimen collected there are 42 septa in four cycles, the first three cycles complete, the fourth nearly so. The septa of the first cycle are moderately exsert, those of the later cycles successively less exsert. All of the septa are thicker at the margin of the calice than farther in where they become attenuate. The primary septa are thicker and wider than those of later cycles. The upper edges of the septa are well rounded at the calicular margin, but then descend nearly vertically before the pali. The pali are robust, irregularly granular or compound above, and occur before all of the larger septa in crowded circlets where they become confused with the papillae of the columella. Along the summit edge and on the side the septa are granulose, the individual tubercles short, strong, pointed and imperforate. There are at least three rows of granulations on the faces of the larger septa and about seven denticles along the summit of a septum 1.4 mm in length. The columella is well developed and papillose.

Measurements. — Specimen S574a: height of corallite 5.5 mm; diameter of corallite at base 4.6 mm; diameters of calice 4.3×3.3 mm; depth of calice to top of pali 0.86 mm.

Locality. — North flank of Punta Gorda anticline at W-23. Playa Grande Formation (Maiquetía Member). One specimen.

Remarks. — Making allowances for its small size and squatty rather than elongate-conical shape, the Venezuelan fossil otherwise is identical with Recent specimens of *Paracyathus defilippii* I have seen in the U. S. National Museum. Compared with other fossil species, the Venezuelan form is close to *Paracyathus vaughani* Gane from the upper Miocene of Virginia and North Carolina. (See Gane 1900, p. 185, pl. 15, figs. 4-6, and Vaughan 1904a, p. 438, pl. 122, figs. 1-3).

Range and distribution. — Other than the present report of its occurrence in the Pliocene of Venezuela, *Paracyathus defilippii* Duchassaing and Michelotti (and its congeners *P. confertus* Pourtalès, *P. agassizi* Duncan, and *P. laxus* Pourtalès) is known only in the Recent. In Western Atlantic-Caribbean waters the species occurs in the Bahamas (Bimini); off Habana, Cuba (36-805 fathoms); in Puerto Rico (Mayaguez 8.5 fathoms and Boca Prieta 30 fathoms); off Sta Cruz, St. Kitts, Montserrat, Dominica, Grenada, Bequia, and St. Thomas in the Antilles (56 to 458 fathoms), and along the west coast of Barbados. In the Eastern Atlantic the species is reported southwest of Cape St. Vincent, Portugal (91 meters to 248 fathoms) and from the Azores in 145 to 454 meters. Moseley reported *P. defilippii* from the Arafura Sea between Australia and New Guinea at a depth of 49 fathoms.

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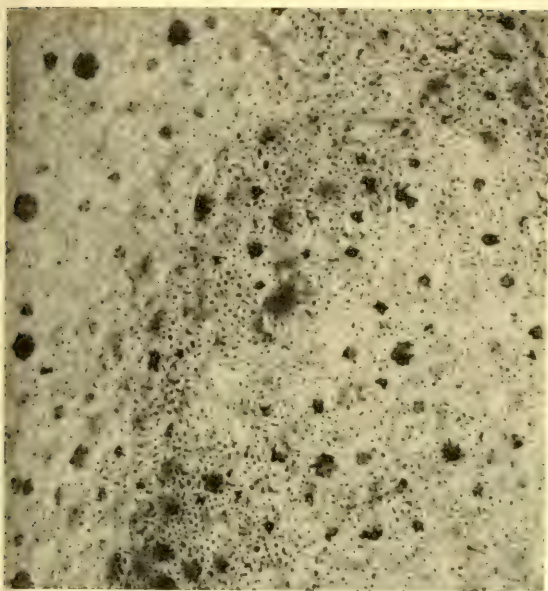
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PLATES

EXPLANATION OF PLATE 1

<i>Figure</i>	<i>Page</i>
1-4. Millepora alcicornis Linnaeus	16
Specimen B562a, 27555 PRI. Width 54 mm, height 50 mm. 1, 2. Views of opposite sides of frond, X 0.9. 3. Same as figure 2 but double natural size. 4. Greatly magnified view showing the porous structure of the coenosteum, a number of alveolae, and the cyclosystems of dactylopores around the gastropores. Recent. Washed up on beach southeast of Higuerote, State of Miranda.	



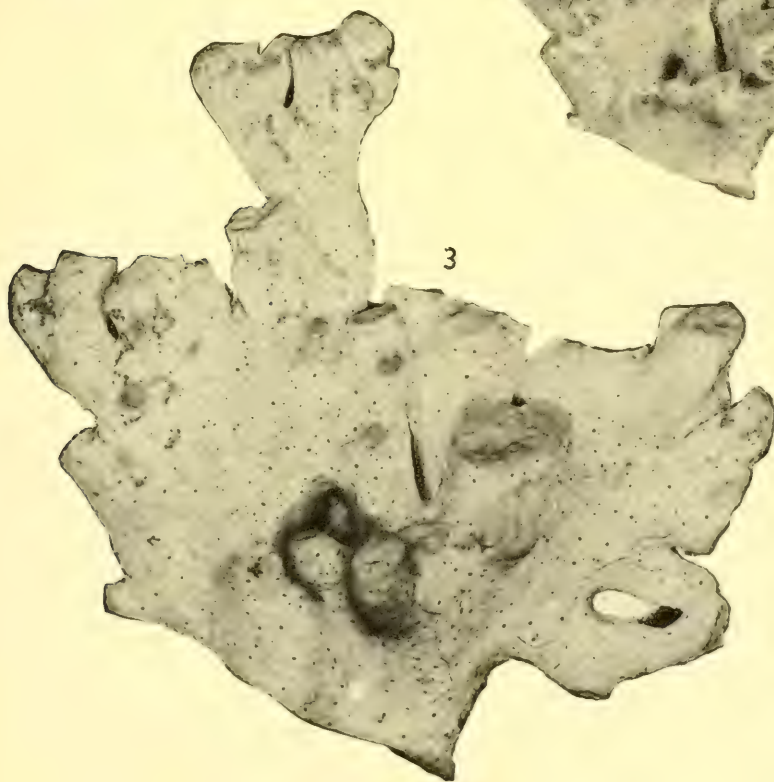
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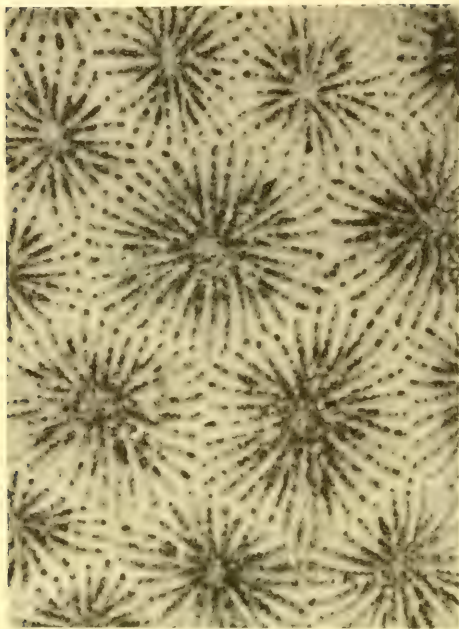
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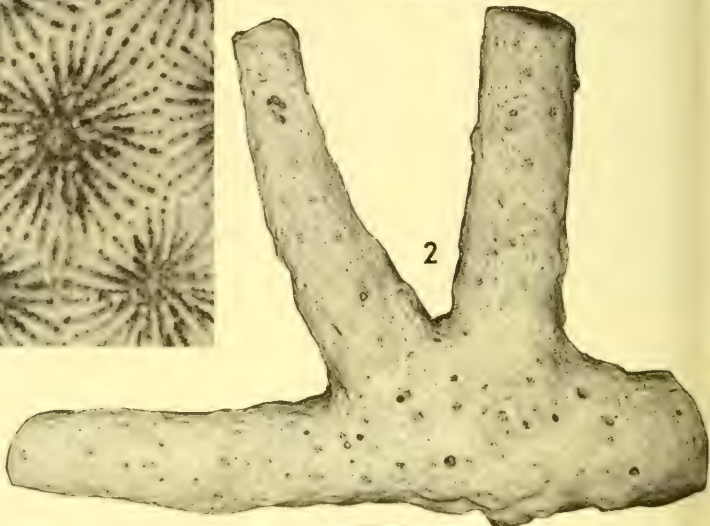
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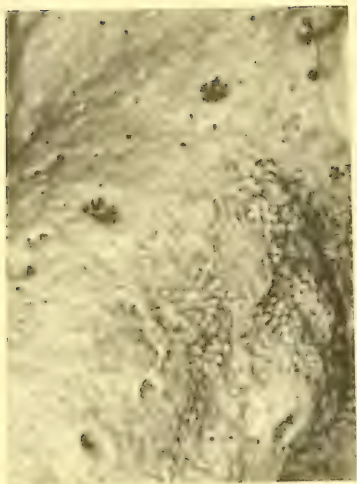
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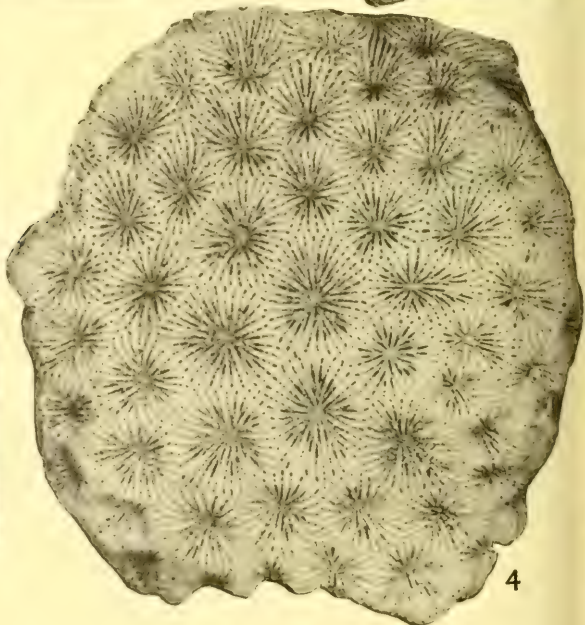
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2



3



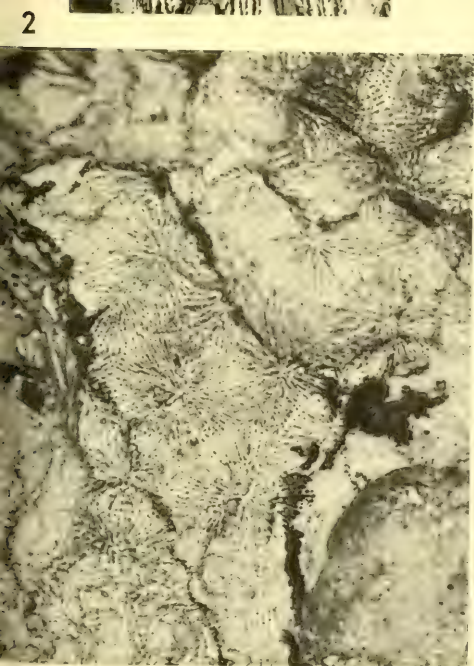
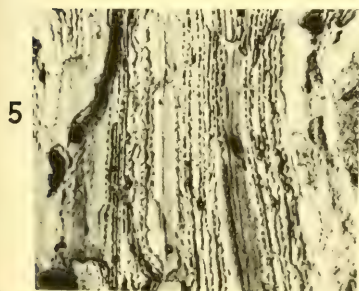
4

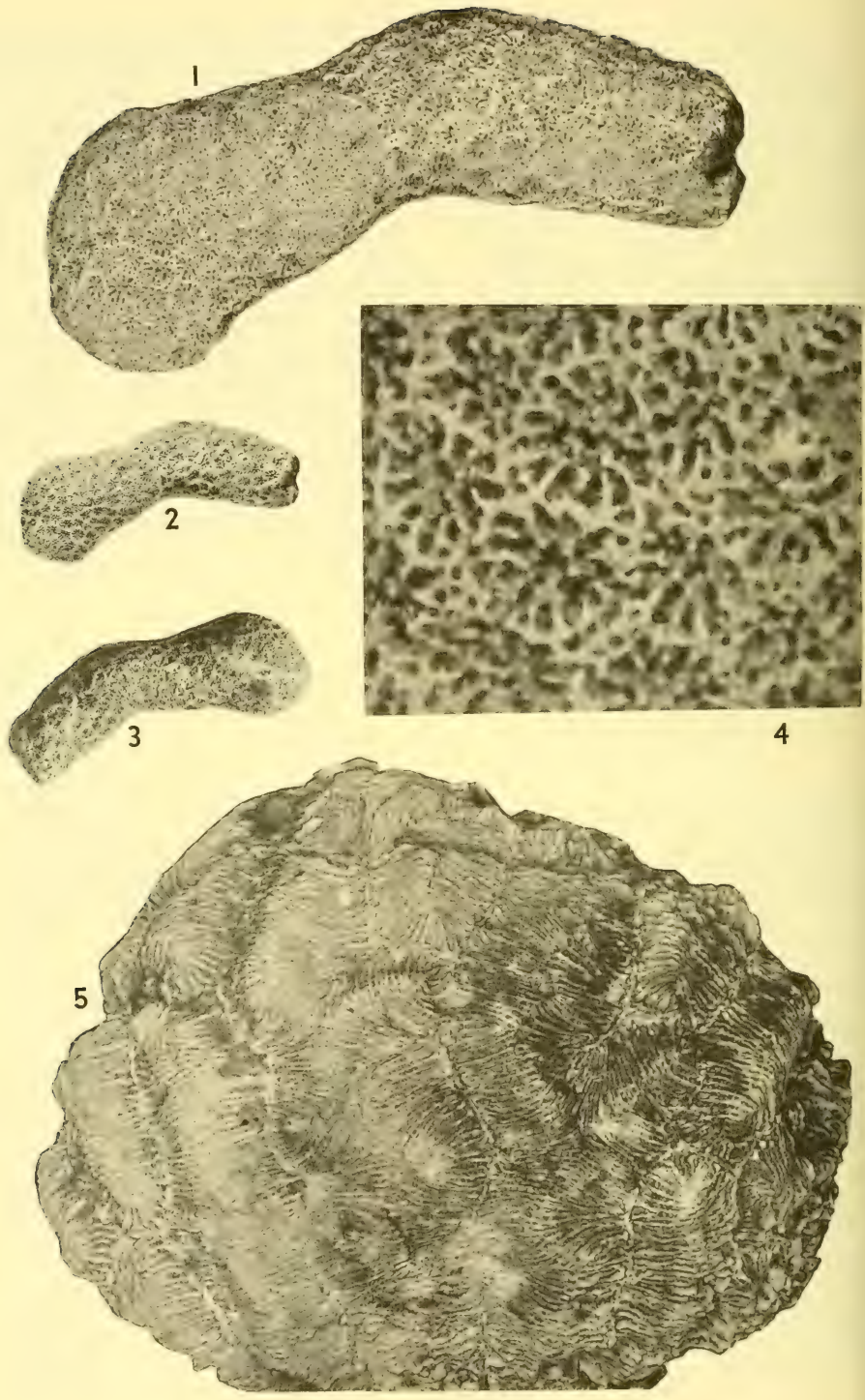
EXPLANATION OF PLATE 2

<i>Figure</i>	<i>Page</i>
1-3. Acropora prolifera (Lamarck)	21
Specimen B563a, 27556 PRI. Length of largest branch of corallum 46 mm. 1. One side of corallum, X 1.2. 2. Opposite side of corallum, X 2. 3. View of crotch between branches showing papillose coenosteum, X 8. Recent. Washed up on beach southeast of Higuerote, State of Miranda.	
4,5. Siderastrea (Siderastrea) radians (Pallas)	28
Specimen B569a, 27557 PRI. Length of corallum 25 mm, width 23 mm. 4. Calicular surface, X 3. 5. View showing details of calices, X 6. Recent. Washed up on beach southeast of Higuerote, State of Miranda.	

EXPLANATION OF PLATE 3

<i>Figure</i>	<i>Page</i>
1-5. Siderastrea (Siderastrea) siderea (Ellis and Solander)	33
Specimen S567a, 27558 PRI. Corallum length 78 mm, width 63 mm, height 86 mm. 1. Lateral view of corallum, X 0.8. Note pelecypod valves in boring at lower left. 2, 3. View of calices looking down on upper surface of corallum, X 3. 4, 5. Views of side showing exposed costae and synapticulae. Playa Grande Formation (Maiquetía Member). Lower Pliocene.	



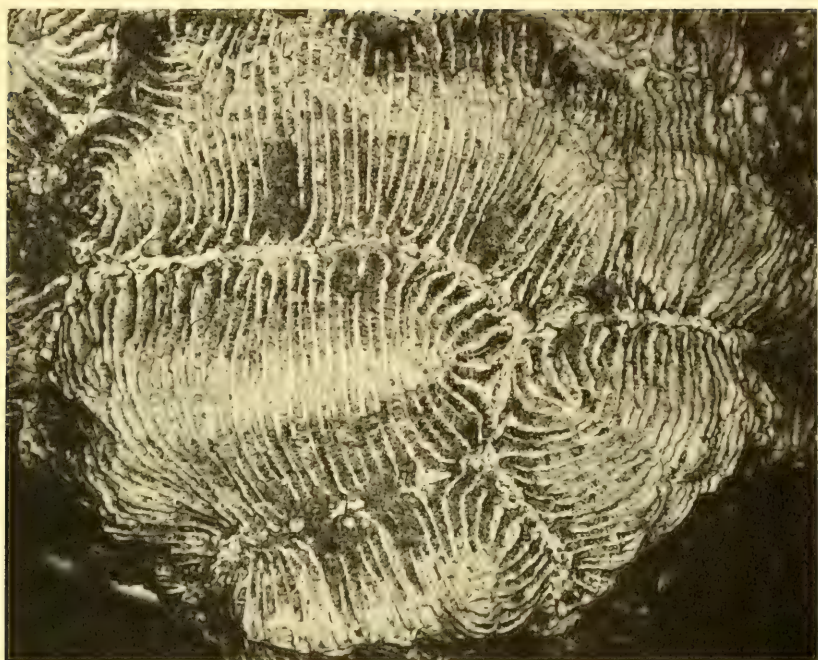


EXPLANATION OF PLATE 4

<i>Figure</i>	<i>Page</i>
1-4. Porites furcata Lamarck	38
Specimen A575a, 27559 PRI. Length of branch 32.5 mm. 1. View of one side, X 3. 2. View of same side, slightly enlarged. 3. View of opposite side, slightly enlarged. 4. View of calices showing pali, X 10. Recent. Washed up on beach of Playa Grande Yachting Club, Distrito Federal.	
5. Manicina areolata puntagordensis , n. subsp.	51
Holotype (S566a), 27560 PRI. Length 119 mm, width 92 mm, height 63 mm. About natural size. Playa Grande Formation (Maiquetía Member). Lower Pliocene. (See Pl. 5, figs. 1-5; Pl. 12, fig. 4 for other views of same specimen.)	

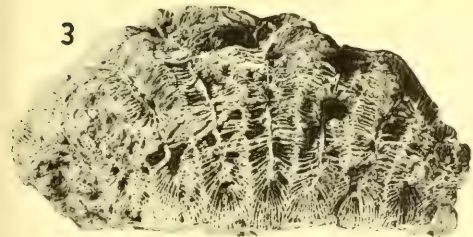
EXPLANATION OF PLATE 5

<i>Figure</i>		<i>Page</i>
1-5.	<i>Manicina areolata puntagordensis</i> , n. subsp.	51
	Holotype (S566a), 27560 PRI. Length 119 mm, width 92 mm, height 63 mm. 1-3. Views of upper surface, base, and side, X 0.5. 4. Portion of base enlarged to show character of costae and epitheca. 5. Enlargement of upper surface of corallum showing columellas, collines, valleys, and septa. Playa Grande Formation (Maiquetía Member). Lower Pliocene. (See Pl. 4, fig. 5; Pl. 12, fig. 4 for other views of same specimen.)	

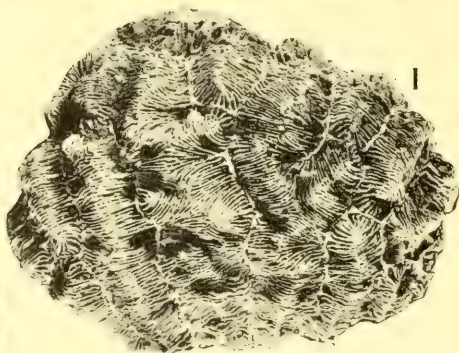


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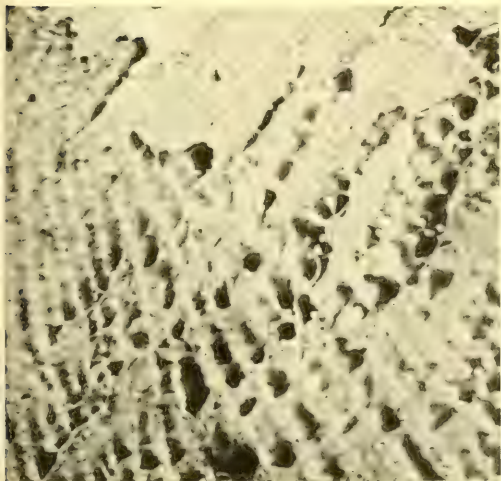
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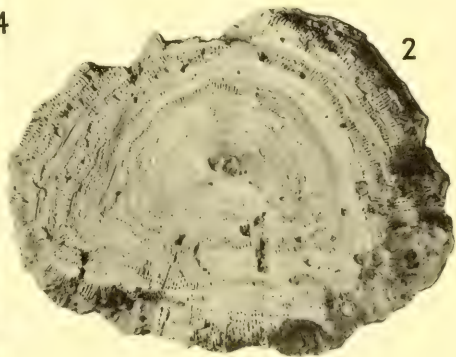
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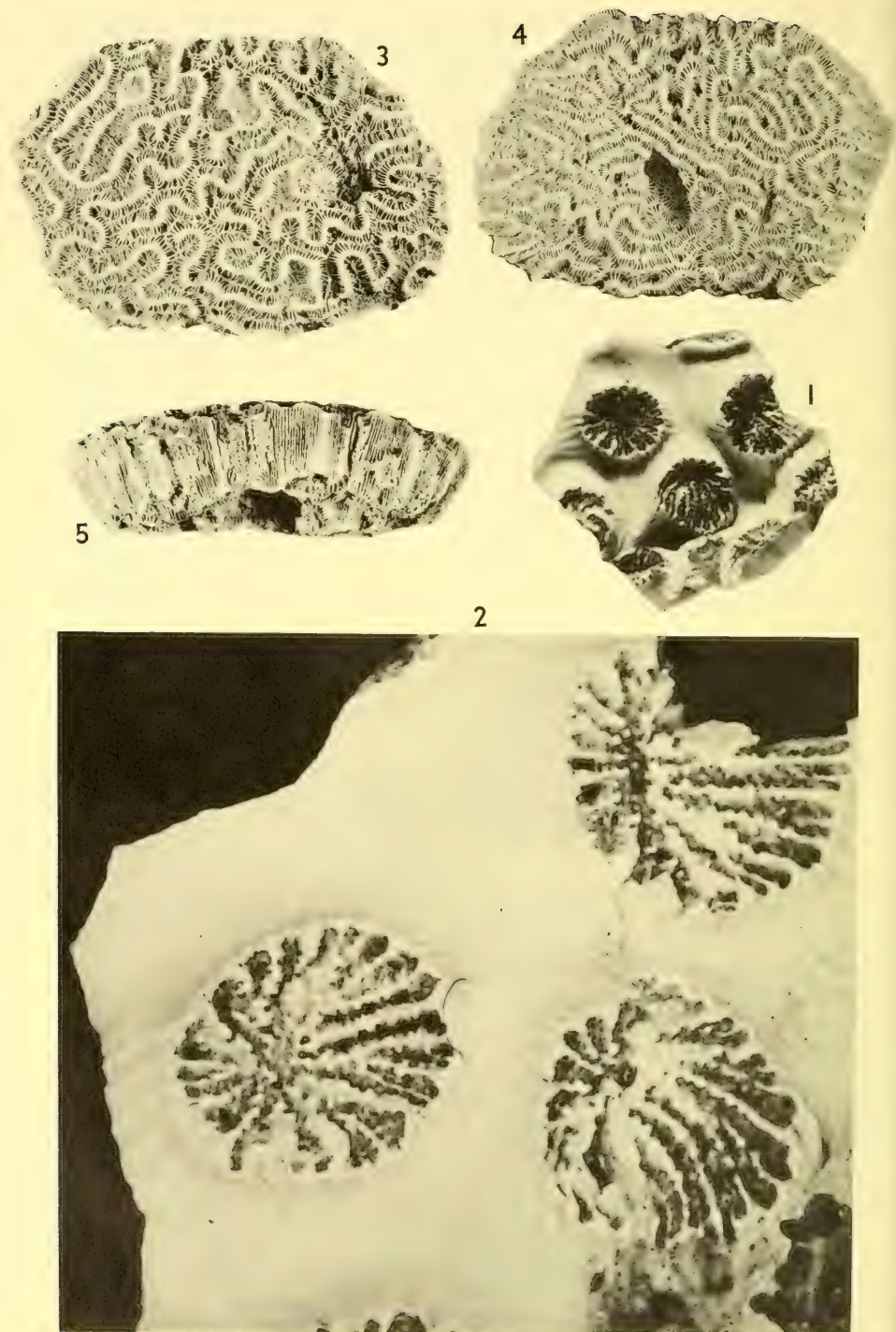


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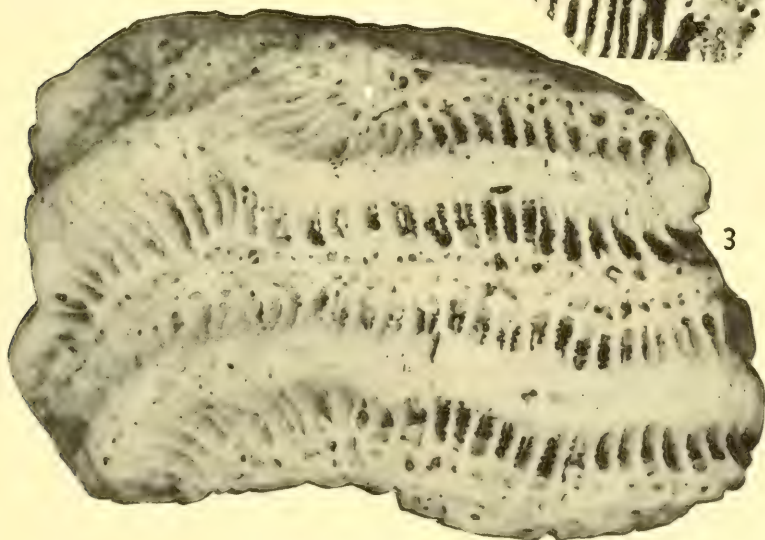
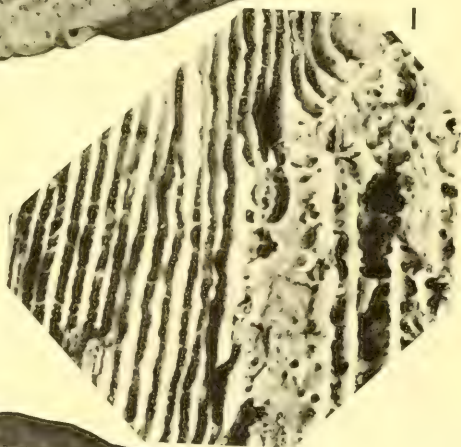
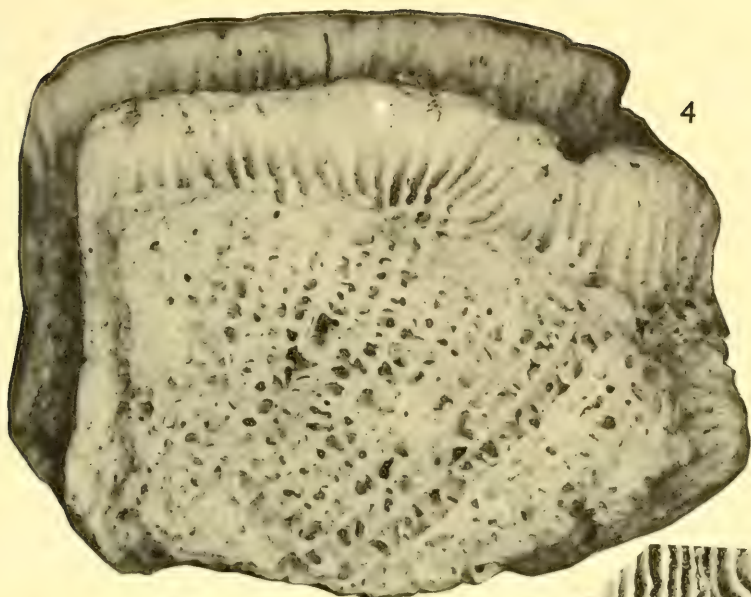


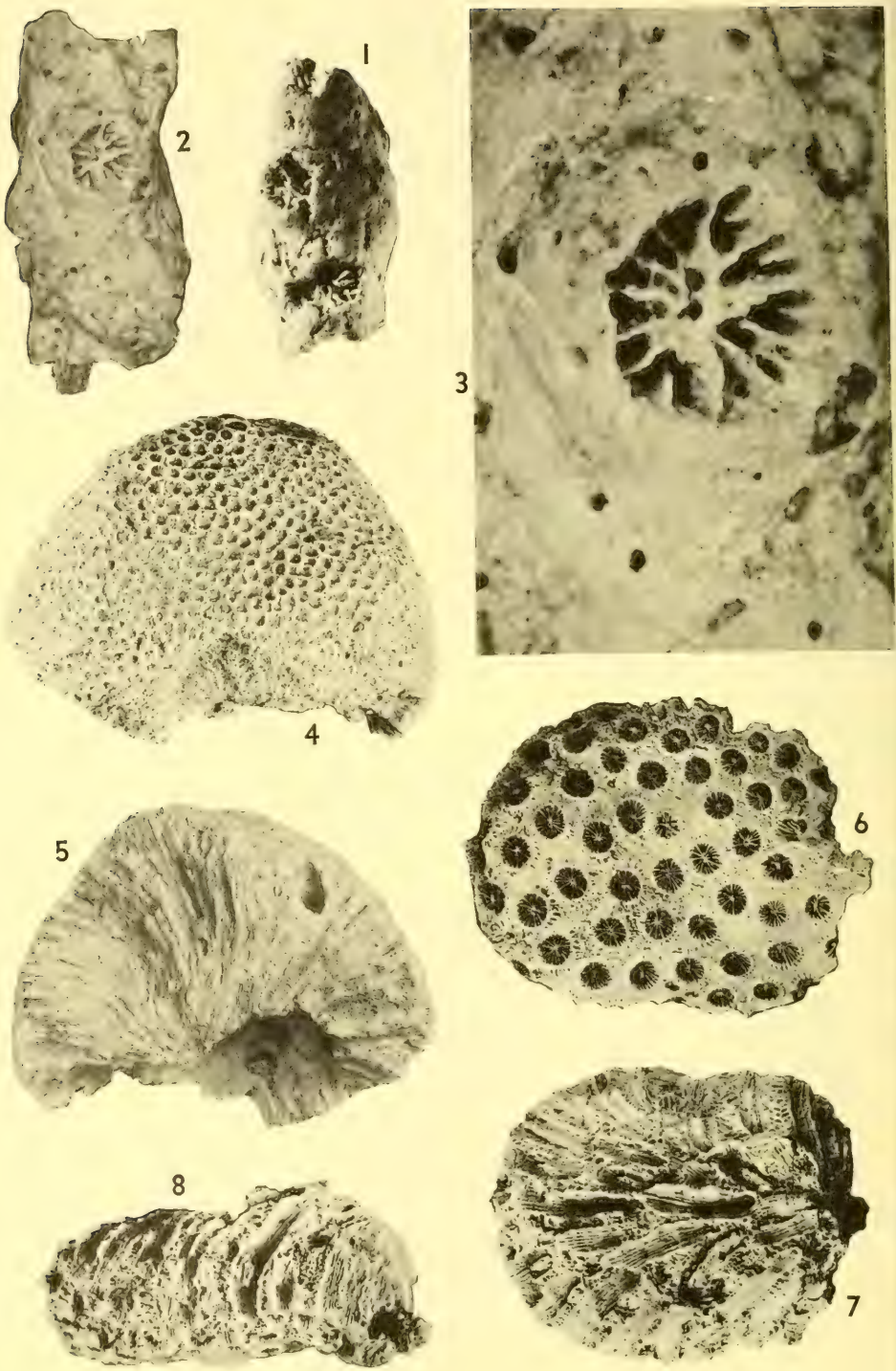
EXPLANATION OF PLATE 6

<i>Figure</i>	<i>Page</i>
1,2. Oculina sp. cf. O. valenciennesi Edwards and Haime	65
Specimen I571a, 27561 PRI. Corallum length 14 mm, width 13 mm, thickness 2.2 mm. 1. View of calicular surface, X 3. 2. View of calices, X 12. Lower Mare Formation. Lower Pliocene.	
3-5. Diploria strigosa (Dana)	46
Specimen N565a, 27562 PRI. Corallum length 120 mm, width 80 mm, thickness 30 mm. Views of upper surface, lower surface, and side, X 0.5. Playa Grande Formation (Catia Member). Lower Pliocene. (See Pl. 7, fig. 1 for details of costae and columella.)	

EXPLANATION OF PLATE 7

<i>Figure</i>	<i>Page</i>
1. Diploria strigosa (Dana)	46
Specimen N565a, 27562 PRI. Enlarged view of side showing details of exposed costae and columella. Playa Grande Formation (Catia Member). Lower Pliocene. (See Pl. 6, figs. 3-5 for views of corallum.)	
2-4. Diploria strigosa (Dana)	46
Specimen A565a, 27563 PRI. Corallum fragment, length 25 mm, width 14 mm, height 20 mm. 2. View of upper surface showing collines, valleys, septa, and columella, X 2. 3. Same as fig. 2, X 4. 4. Longitudinal view along columella showing septa (above) and costae on side, X 4. Recent. Washed up on beach of Playa Grande Yachting Club, Distrito Federal.	



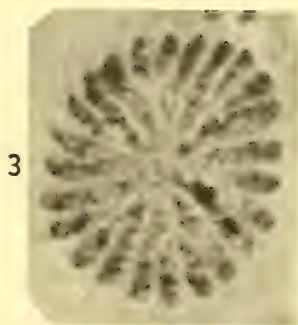
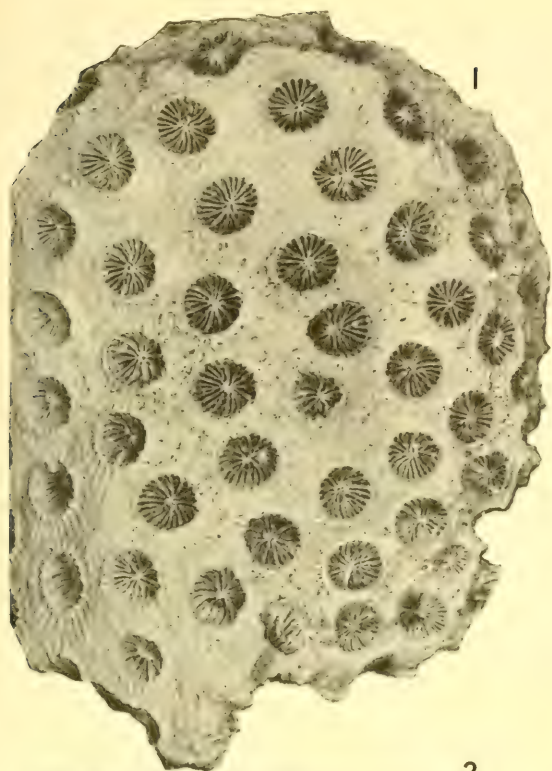


EXPLANATION OF PLATE 8

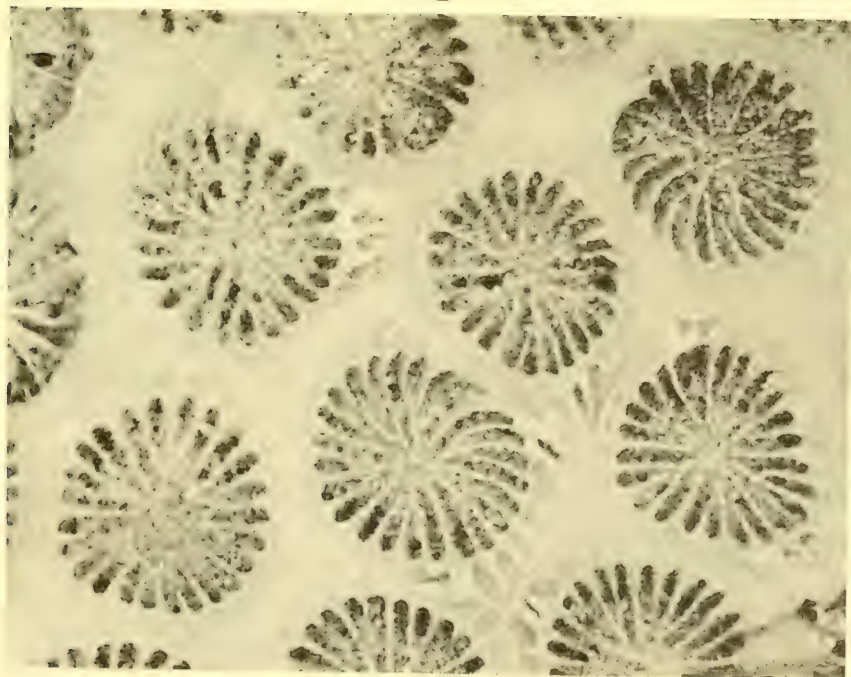
<i>Figure</i>		<i>Page</i>
1-3.	Oculina diffusa Lamarck	62
	Specimen D577a, 27564 PRI. Corallum fragment, length 12 mm, maximum diameter 5 mm. 1. View of one side, X 3.5. 2. View of opposite side, X 4.5. 4. Enlarged view of figure 2 showing details of calice and coenosteum. Abisinia Formation. Lower Pleistocene.	
4,5.	Solenastrea hyades (Dana)	57
	Specimen J568a, 27565 PRI. Corallum length 79 mm, width 68 mm, height 60 mm. Views of upper surface and exposed walls of side, X 0.75. Lower Mare Formation. Lower Pliocene.	
6-8.	Solenastrea hyades (Dana)	57
	Specimen C570a, 27566 PRI. Corallum fragment, length 35 mm, width 28 mm. Views of upper surface, under surface, and side, X 1.6. Guaguaza Clay. Upper Pliocene. (See Pl. 9, figs. 1-4 for details of same specimen.)	

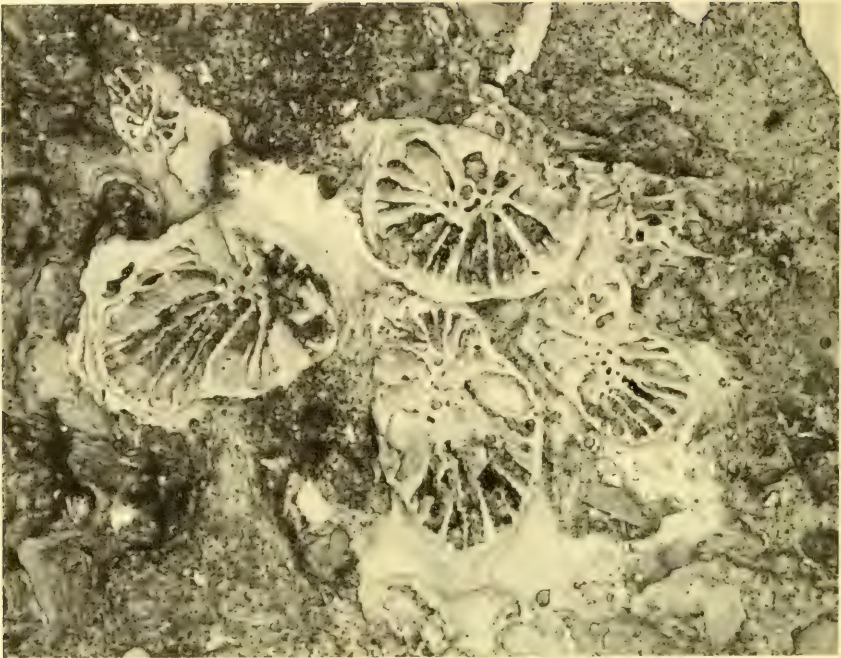
EXPLANATION OF PLATE 9

<i>Figure</i>	<i>Page</i>
1-4. Solenastrea hyades (Dana)	57
Specimen C570a, 27566 PRI. Corallum fragment, length 35 mm, width 28 mm. 1. Calicular surface, X 2.8. 2. View of calices and blistered coenosteum, X 11. 3, 4. Individual calices showing character of septa, X 15. Guaiguaza Clay. Upper Pliocene. (See Pl. 8, figs. 6-8 for other views of same specimen.)	

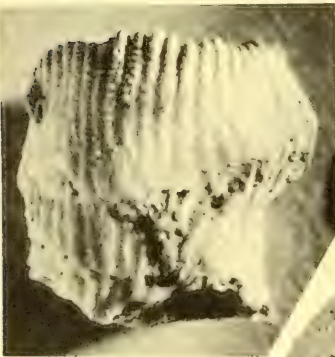


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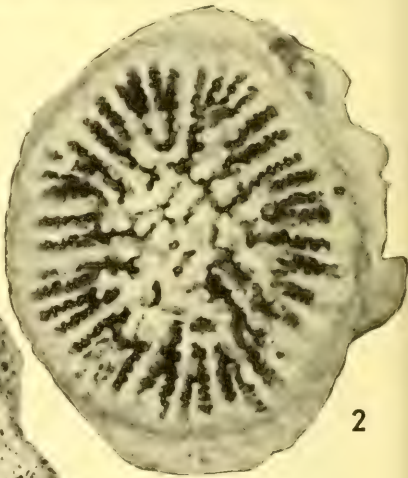




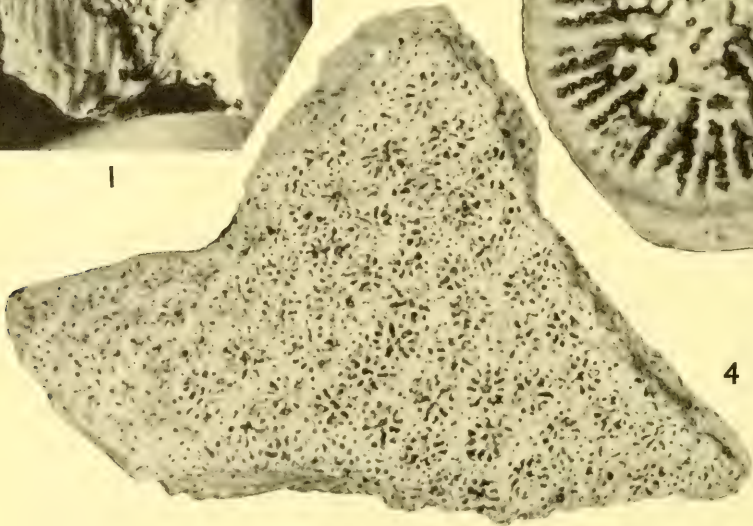
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2



4

EXPLANATION OF PLATE 10

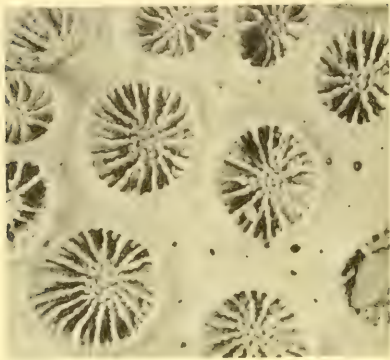
<i>Figure</i>		<i>Page</i>
1,2.	Paracyathus defilippii Duchassaing and Michelotti Specimen S574a, 27568 PRI. Height of corallite 5.5 mm; diameters of calice 4.3 mm x 3.3 mm. 1. Side view of corallite, X 7. 2. En- larged view of calice showing septa and pali. Playa Grande Formation (Maiquetia Member). Lower Pliocene.	71
3.	Phyllangia americana Edwards and Haime Specimen S688a, 27569 PRI. Length of colony 29 mm, width 20 mm. Enlarged 3 X. Playa Grande Formation (Maiquetia Mem- ber). Lower Pliocene. (See Pl. 11, fig. 1.)	68
4.	Porites branneri Rathbun Specimen C575a, 27570 PRI. Corallum fragment, height 12.5 mm, width 20.2 mm. Guaiguaza Clay. Upper Pliocene.	42

EXPLANATION OF PLATE 11

*Figure**Page*

1. **Phyllangia americana** Edwards and Haime 68
Specimen S688a, 27569 PRI. Length of colony 29 mm, width 20
mm. Enlarged 8 X. Playa Grande Formation (Maiquetía Mem-
ber). Lower Pliocene. (See Pl. 10, fig. 3.)

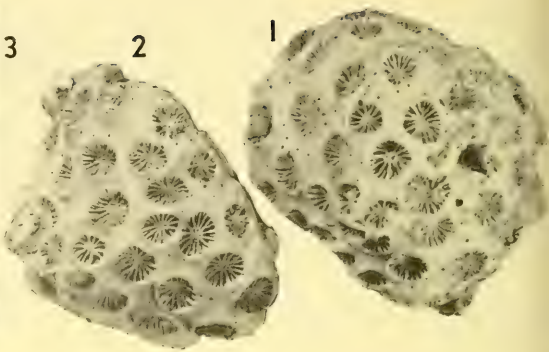




3

2

1



4



EXPLANATION OF PLATE 12

<i>Figure</i>	<i>Page</i>
1-3. <i>Solenastrea</i> cf. <i>S. bournoni</i> Edwards and Haime	60
Specimen H570a, 27571 PRI. Corallum length 27 mm, width 21 mm, height 19 mm. 1,2. Views of upper surface, X 1.4. 3. Enlarged view of calices, X 3. Mare formation. Lower Pliocene.	
4. <i>Manicina areolata puntagordensis</i>, n. subsp.	51
Holotype (S566a), 27560 PRI. Length 119 mm, width 92 mm, height 63 mm. Enlargement showing details of epitheca, costae, and area of attachment. Playa Grande Formation (Maiquetia Member). Lower Pliocene. (See Pl. 4, fig. 5; Pl. 5, figs. 1-5 for other views of same specimen.)	

INDEX

Number 246

Note: Light face figures refer to the page numbers. Bold face figures refer to the plate numbers.

A		B	
Abaco, Bahamas	20, 33	Bahamas	20, 24, 27, 32, 38, 42, 43, 46, 50, 60, 62, 65, 68, 71, 73
Abisinia Formation ..	6, 8, 9, 12, 14, 49, 50, 65	Bahía, Brazil	32, 71
Abrolhos Reef,		Bahia de Boqueron,	
Brazil	32	Puerto Rico	62
Acropora	21	banksi, Oculina	68
agassizi, Para-		Barahona, Domini-	
cyathus	71, 73	can Republic	38, 42
Aguadilla, Puerto		Barbados	20, 24, 27, 33, 38, 42, 46, 51, 57, 65
Rico	57	Barnacles	13
Alacran Reef,		Bequia	73
Mexico	20, 27, 33, 38, 42, 46, 51	Bermuda	20, 32, 38, 46, 51, 65
Alâgoas, Brazil	43	Bermúdez, Pedro J.....	11, 85
alcicornis, Mille-		Bermúdez, Pedro J.,	
pora 1	8, 16-19, 20, 21, 270	and Fuenmayor,	
, Palmipora	16	Angel, N.	11, 85
americana,		bermudiana, Oculina	68
Phyllangia 10, 11	6, 8, 68-71, 279, 280	Big Pine Key,	
Andros Island,		Florida	42
Bahamas	24	Bimini, Bahamas	20, 27, 33, 46, 65, 73
Anegada Reef,		Bird Key Reef,	
Mexico	42	Tortugas	33
Anthozoa	14, 15, 21	Black Swamp, Panama	
Antigua	20, 27, 51, 57	Canal Zone	46, 57
Arafura Sea	73	Blanquilla Reef,	
arbuscula, Oculina ..	68	Mexico	27, 38, 42, 51
areola, Madrepora ..	53	Bluefields Bay,	
, maeandrina ..	53	Jamaica	57, 62
areolata, Madrepora ..	53	Boca Prieta, Puerto	
, Maeandrina ..	53, 54	Rico	73
, Manicina	6, 52, 54	Bonaire	20, 51
areolata punta-		Boschma, Hilbrand ..	19, 88-93
gordensis,		bournoni,	
Manicina 4, 5, 12	5, 6, 8, 51-53, 273, 274, 281	Solenastrea 12	8, 59, 60-62, 281
Aruba	38, 51	Bowden, Jamaica	38
astroites, Astraea	28	branneri,	
, Madrepora ..	28	Porites	10 8, 42-43, 279
Awa di Ostpunt,			
Curaçao	46		
Azores	73		

INDEX

Brazil	20, 43, 71	Chlorophyceae		15
braziliensis,		Cienaga, Cuba		60
Millepora	20	Cirripedia		13, 14
Brimstone Hill, St. Kitts	57	clavaria, Porites		40, 41, 44, 46
British Honduras	20, 24, 27, 33, 38, 42, 43, 46, 51, 57, 62, 65	clivosa, Diploria		50
	24, 96	Coelenterata		16
Brook, George	11, 13	Colombia		20, 57
Bryozoa		complanata, Millepora		20
		confertus, Paracyathus		71, 72, 73
		Corals, list of		8
C		coronalis, Oculina		68
Caballo Ahogado, Puerto Rico	62	Costa Rica		38, 42, 51, 57
Cabo Blanco area	5, 6, 9, 10, 12, 38	crassa, Meandrina		46
Cabo Blanco Group	6, 7, 9, 11, 12	crenulata antillarum, Siderastraea		34
caboblanquensis,		crispata, Manicina		34
Ostrea (Alectryonia)	70	crista-galli, Millepora		21
Caesar's Creek, Florida	60	crustacea, Millepora		21
Caloosahatchee River, Florida	57, 60	Cuba		20, 27, 33, 37, 38, 46, 51, 58, 60, 62, 65, 68, 73
Candeias Reef, Brazil	43	Cubagua, Venezuela		21, 33
candida, Millepora	21	Culebra, Panama		
Cape Verde Islands	32	Canal Zone		20, 24, 38
Carabobo, State of	5, 7, 8, 9, 59	Curaçao		20, 24, 27, 33, 38, 42, 43, 46, 51, 57, 62
Caracas Baai (Bay), Curaçao	24, 42, 43, 46, 51			
Caravellas, Brazil	71			
caribaea, Leptastrea	60			
carpinetti, Plesiastrea	60			
Cartagena, Colombia	20	Daimarie, Aruba		51
carthaginiensis, Millepora	21	danai, Manicina		54
Catia Member (Playa Grande Formation)	9	Dasycladales		15
Cayo Icacos, Puerto Rico	57	defilippii, Paracyathus	10	6, 8, 71-73, 279
Cedar Keys, Florida	60	delicatula, Millepora		21
cerebrum, Maendrina	47, 48	diffusa, Oculina	8	8, 62-65, 67, 68, 277
cervicornis, Acropora	23, 24, 25, 26, 27	digitata, Millepora		21
, Heteropora	24	dilatata, Manicina		54
, Isopora	25	Diploria		46
, Madrepora	24	distsans, Plesiastrea		60
Cheilostomata	14, 15			

INDEX

Distrito Federal,		Gallardo Bank,	
Venezuela	5, 7, 50	Puerto Rico	27
divaricata, Porites	41	Gallows Island,	
Dominica	73	Bermuda	32
Dominican		Gane, Henry	
Republic	32, 38, 42,	Stewart	73, 134
	57, 60	Gastropoda	6, 12, 13, 14,
			15
E		Gatuncillo Formation	
East Flower		(Panama)	21
Garden Bank	51	gatunensis,	
Elbow Key,		Oculina	68
Bahamas	71	globosa, Plesiastraea	60
ellisii, Solenastrea	60	, Siderastrea (?)	33
Ensenada,		Glover's Reef,	
Puerto Rico	57	British Honduras ..	20, 27, 38, 42,
esper, Millepora	21		46, 51
excelsa,		gothica, Millepora	21
Solenastrea	58	grandis,	
		Siderastrea	34
F		Great Bahama Bank	27
fasciculata,		Gregory, John Walter	24, 143
Millepora	21	Grenada	57, 73
Fernando Po	32	Guadeloupe	20, 27, 33, 57
filigrana,		Guaiguaza Clay	6, 8, 9, 11, 12,
Maeandrina	47		14, 43, 59, 60
flabelliformis,		Gulf Coast, U.S.A.	12
Porites	46	Gulf of Guinea	32
flexuosa, Porites	46	Gurabo Formation	
Florida	12, 20, 24,	(Dominican Republic)	60
	32, 33, 38,	Gymnolaemata	13, 14, 15
	46, 51, 62	gyrosa, Manicina	52, 53
Florida State		H	
University	7	Habana, Cuba	60, 73
Fontein, Bonaire	51	Haiti	51
Foraminiferida	6, 11, 12,	Harrington Sound,	
	13, 14, 15	Bermuda	20
forskali, Milleport	21	heterogyra,	
Fort Jefferson,		Meandrina	46, 47
Tortugas	33	hieroglyphica,	
fragilis, Meandrina	46, 47	Leptoria (?)	46, 47
France	12	Higuerote	5, 6, 7, 19,
Fresh Creek			23, 32
fossil reef	24, 27, 33, 50	hispida, Manicina	53
furcata, Heliopora	38	Honda, Puerto Rico ..	57
furcata, Porites	4 8, 38-42, 273	hyades, Astrea	57
		, Heliastrea	57
G		, Orbicella	57
Gabb, William M.	42, 133	, Solenastrea 8, 9	8, 57-60,
galaxea, Astraea	28, 29		277, 278
, Explanaria	28	Hydrozoa	16
, Madrepora	28		
, Siderastrea	28	I	
, Siderina	28, 29	implicata, Oculina	68

INDEX

Isla de Lobos, Mexico	33, 38, 42, 43, 46, 51	Maiquetía Member (Playa Grande Formation)	6, 9, 10, 37, 50
Isla Sacrificios, Mexico	42	Manicina	51
Isla Verde, Mexico.....	33, 42	Mare Abajo, Quebrada	8, 10, 59, 67
Italy	12	Mare Formation	6, 8, 9, 10, 12, 13, 14, 59, 60, 62, 67
J		Margarita, Venezuela	27
Jamaica	20, 24, 27, 33, 37, 38, 42, 46, 51, 57, 60, 62, 65, 68, 71	Martinique	65, 71
K		Matthai, George	53, 184, 185
Kaap Malmeeuw, Curaçao	46	Mayaguez, Puerto Rico	20, 57, 73
Key Largo Lime- stone (Florida)	27, 33, 42, 46, 50	mayori, Manicina	52, 53
Key West, Florida	60	Mesolella, Kenneth J.	27, 188
Kingston, Jamaica	33	Mexico	20, 27, 33, 42, 43, 46, 65
L		Miami, Florida	60, 65
labyrinthica, Maeandrina	47	micans, Solenastrea	60
labyrinthiformis, Diploria	50	Miranda, State of	5, 7, 19, 23, 32
La Cruz Marl (Cuba)	46, 60, 62	Moin, Costa Rica	27
Las Pailas Formation (Venezuela)	9, 10	Mollusca	6, 11, 12, 13
La Parguera, Puerto Rico	20	moniliformis, Millepora	21
laxus, Paracyathus	71, 73	Monkey Point, Costa Rica	51, 57
Lighthouse Reef, British Honduras ..	20, 27, 38, 46, 51, 57	Montserrat	60, 73
Lime Clay, Jamaica	46	Moselle Bank, Bahamas	20
Lithothamnium reef ..	6, 37, 52, 70	Mt. Hope, Panama Canal Zone	20, 27, 33, 38, 42, 46, 57, 65
Litoral anticline	8, 50	Mulders, Gerrit	7
Loggerhead Key, Tortugas	33	muricata, Acropora	25
Louisiana, U.S.A.	12	, Isopora	22, 25
Lyell, Sir Charles	10, 11, 12	, Madrepora	22, 24
M		, Millepora ..	24
Maceio Reef, Brazil ..	43	muricata cervicornis, Acropora	25, 26
macrocephala, Porites ..	46	muricata <i>forma</i> cervicornis, Madrepora (Eumad- repora)	25
Madden Basin, Panama	21	muricata porlifera, Acropora	22
		N	
		Natal, Brazil	43
		National Science Foundation	7
		Nivajé Shale (Dominican Republic)	57
		nitida, Millepora	20
		nodifera, Porites	46
		North Carolina, U.S.A.	73

INDEX

O

oblita, Cyphastrea	60
Ocho Rios, Jamaica	20, 46, 57
oculata, Oculina	68
Oculina	62
Osprey, Florida	60

P

Paleontological Research Institution ..	7
pallens, Oculina	68
palmata, Acropora	24
Palmer, Katherine V. W.	7
Panama	21, 33, 38, 42, 46, 57, 65
Panama Canal Zone	20, 33, 38, 46, 57, 65
Paracyathus	71
Parahyba do Norte, Brazil	43
Pedro Bank, British Honduras	24, 27, 38, 43, 51, 57, 65
Pelecypoda	12, 13, 14, 15
Pelican Cay, Jamaica	20
Pescadera (Piscadera) Baai, Curaçao	33, 34, 62
Pernambuco, Brazil	43
petiveri, Oculina	68
Phyllangia	68
Playa Grande Formation	6, 9, 10, 12, 13, 49
Playa Grande Formation (Catia Member)	8, 15, 50
Playa Grande Formation (Maiquetia Member)	8, 15, 37, 52, 70, 73
Playa Grande village	8, 50, 65
Playa Grande Yachting Club	5, 7, 41
pliocenica, Manicina	54
plumieri, Porites	46
Polychaetia	14, 15
polymorpha, Porites	39, 44, 46
porites furcata, Porites	39, 40, 41
porites, Madrepora	44
, Porites	39, 41, 43, 44-46
Portland Bight, Jamaica	24

Portugal	73
Pourtales, Louis François de	33, 71, 209
praerupta, Manicina ..	54
prolifera, Acropora ..	2, 8, 21-24, 271
, Madrepora ..	21
Puerto Cabello, Venezuela	8, 43, 59
Puerto La Cruz, Venezuela	24, 35, 42, 51, 65, 68
Puerto Rico	20, 24, 27, 33, 38, 46, 51, 57, 62, 65, 73
pumila, Millepora	21
punctifera, Astraea ..	28
, Astreaepora ..	28
Punta Gorda anticline	8, 52, 59, 62, 70, 73

Q

Quelch, John Joseph	57, 211
---------------------------	---------

R

Rabbit Cay, Bahamas	20, 51
radians <i>seu</i> astroites, Astraea	28
radians, Astrea	29
, Madrepora ..	28
, Siderastrea (Siderastrea)	2, 8, 29-31, 271
ramosa, Millepora	21
Rathbun, Richard	41, 212
recta, Oculina	68
, Porites	38, 46
Red Sea	32
Rendezvous Cay, British Honduras ..	24, 33, 38, 42, 46, 51, 57, 62
Rio Cana, Dominican Republic	38, 62
Rivero, Frances Charlton de	33, 216
robusta, Oculina	68
Rockham Cay, Jamaica	46

S

Sail Rock, St. Thomas	57
-----------------------------	----

INDEX

St. Bartholomew	57	squarrosa, Millepora	20
St. Eustatius	20, 38, 51, 57	Squires, Donald F.	7, 41, 228
St. George's Sound, Florida	32, 65, 71	Stanley, Steven M.	27, 229
St. Kitts	57, 73	stellata, Sideras- trea	32, 34
St. Michaels (Michiels) Baai, Curaçao	33, 46, 51	strigilis, Manicina	54
St. Thomas	20, 24, 27, 33, 42, 51, 57, 65, 73	strigosa, Diploria	6, 7 46-51, 275, 276
St. Vincent, Cape, Portugal	73	, Meandrina	46, 47, 48
Salina de Guaiguaza	5, 9, 43, 59	Sugar Loaf (St. Eustatius)	27, 57
Sta. Cruz, Cuba	74		
Santa Martha Baai, Curaçao	51, 62	T	
San Thomé (Gulf of Guinea)	32	Thomonde Formation (Haiti)	42
Santiago, Cuba	46	Tortuga, Venezuela	27, 38
Santo Domingo	51	Tortugas (Florida)	20, 24, 33, 38, 42, 46, 51, 57, 62, 65
São Sebastião, Brazil	71	Toula, Franz	68, 239
Scaphopoda	14, 15	Trinidad, British West Indies	20, 38
schrammi, Millepora	21	trinitatis, Millepora	21
Scleractinia	14, 15, 21	Turneffe, British Honduras	24, 33, 46, 51, 57
sebacana, Manicina	54	Turtle Rocks, Bahamas	20
Sedentarida	14, 15		
serpulids	13	U	
serrata, Meandrina	47	United States National Museum	7
Shell Creek, Florida	62		
siderea, Astrea	33, 34	V	
, Madrepora	33	Vagt, Werner	7
, Pavonia	33, 34	valenciennesi, Manicina	54
, Siderastrea (Sideras- trea)	3 8, 32, 33-38, 272	valenciennesi, Oculina	6 8, 65-68, 275
Simmon's Bay (Cape of Good Hope)	57	valida, Porites	46
sinuosissima, Meandrina	46, 47	varicosa, Oculina	68
Smith, Frederick George Walton	41, 59, 226	varicosa conigera, Oculina	68
solanderi, Porites	46	Vaughan, Thomas Wayland	19, 27, 41, 59, 73, 243-246
Solenastrea	57	vaughani, Paracyathus	73
South America	20	Vera Cruz, Mexico	33, 38, 46, 51, 65
South Bimini, Bahamas	20	Vieques Island	38
Spaansche (Spanish) Water, Curaçao	33, 42, 46, 51, 57	virginea, Oculina	68
Spanish Harbor, Florida	32, 42, 46	Virginia, U.S.A.	73
Spanish Port, Curaçao	51		
speciosa, Oculina	68		

INDEX

Virgin Islands	62	White Wall, St.	
viridis, <i>Platygira</i>	47	Eustatius	51
W			
Weisbord, Norman E.	9, 10, 253	Z	
Wells, John West	7, 254-256		
Westpunt Baai,		Zone H (Dominican	
Curaçao	33, 51	Republic)	38, 62

2-3

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MIOCENE AND PLIOCENE MOLLUSKS
FROM TRINIDAD

By

PETER JUNG

1969

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Ithaca, New York 14850 U.S.A.

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CONTENTS

Abstract	293
Acknowledgments	293
Introduction	293
Locality data	295
Melajo River area	295
Point Courbaril	296
Matura	297
Composition of the faunas	297
Melajo fauna	305
Courbaril fauna	306
Matura fauna	306
Ages	307
Melajo fauna	307
Courbaril fauna	309
Matura fauna	310
Affinities to Eastern Pacific Recent genera, subgenera, and species	310
Summary as to ages	313
Systematic paleontology	313
Scaphopoda	313
Pelecypoda	316
Gastropoda	416
References cited	573
Plates	587
Index	636

MIOCENE AND PLIOCENE MOLLUSKS FROM TRINIDAD

PETER JUNG

ABSTRACT

A total of 325 species of mollusks from three stratigraphic units of Trinidad is described and figured. The fauna of the Melajo Clay Member of the Springvale Formation includes 168 species and is correlated with the Savaneta Glauconitic Sandstone Member of the Springvale Formation, but part of it may be somewhat younger. The fauna from the Courbaril Sand and Clay Member of the Upper Morne l'Enfer Formation contains 96 species and is considered to be of early Pliocene age. Also an early Pliocene age is attributed to the fauna (160 species) of the Matura Sand and Clay Member of the Talparo Formation, although the Courbaril fauna appears to be slightly older than the Matura fauna.

ACKNOWLEDGMENTS

The bulk of the material referred to herein has been collected by Dr. H. G. Kugler, who donated part of his collections to the U.S. National Museum. Thanks are extended to Dr. Kugler, with whom I was able to visit the fossil localities in Trinidad, and particularly to the Management of Texaco Trinidad Inc. for hospitality and working facilities.

I am greatly indebted to the Smithsonian Institution and to Dr. G. A. Cooper, then Chairman of the Department of Paleobiology of that institution, for a grant enabling me to stay at the U.S. National Museum. I am obliged to Dr. R. S. Boardman who offered facilities of the Division of Invertebrate Paleontology. Dr. W. P. Woodring generously gave access to his library, his invaluable card file of Caribbean Tertiary Mollusks, to the splendid Caribbean molluscan collections, and — last but not least — to his personal knowledge. I am grateful to Dr. J. Rosewater, Division of Mollusks, Department of Invertebrate Zoology, for the permission to use the mollusk library and the collections of Recent mollusks.

Special thanks are due to Dr. W. S. Cole of Cornell University, Ithaca, New York, for the loan of Maury's types described in 1912, and to Dr. K. V. W. Palmer, director of the Paleontological Research Institution, Ithaca, New York, for hospitality and working facilities during a short stay at that institution.

The director of the Natural History Museum Basel and the trustees of that museum generously supported this project.

INTRODUCTION

The present report deals with the molluscan faunas collected from the following three stratigraphic units of Trinidad: the Melajo Clay Member (Kugler, 1953, p. 54) of the Springvale Formation, the Courbaril Sand and Clay Member (Kugler MS) of

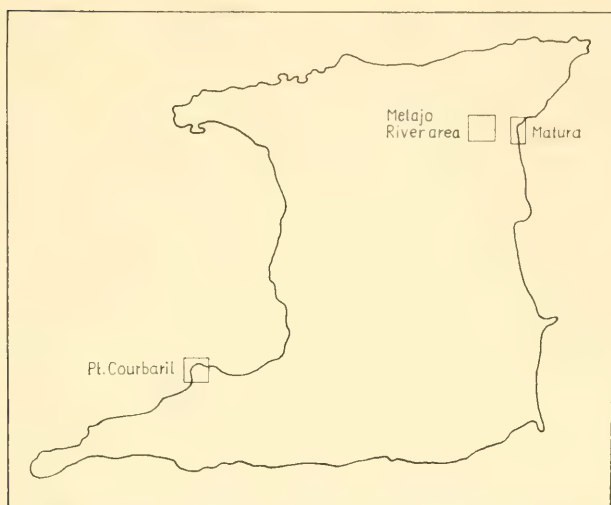
the Upper Morne l'Enfer Formation, and the Matura Sand and Clay Member (Kugler MS) of the Talparo Formation.

There is practically no published information on mollusks from the Melajo Clay. Woodring (1958), in his discussion of *Springvaleia leroyi* (Guppy), referred to two specimens of that species from the Melajo Clay, and estimated the accompanying molluscan fauna to consist of about 120 species. A number of mollusks have been described from the Courbaril beds by Maury (1912, 1925). This fauna proves, however, to be considerably richer than indicated by Maury. The fauna from Matura is known for more than a hundred years. The first faunal list from Matura was published by Guppy in 1864. Subsequently Guppy (1867, 1874) described new species from Matura and gave more complete lists. Additional species from Matura have been described by various authors in different papers.

In 1942 R. F. Rutsch prepared a preliminary report for Trinidad Leaseholds, Ltd. on the Matura fauna. Rutsch realized that without access to Guppy's types a scientific description of the fauna would meet with great difficulty. Most of the species were poorly figured or not at all. The writer was able to study Guppy's types at the U.S. National Museum. Rutsch (1943, private report) also dealt with the mollusks from the Melajo Clay, but the collection at his disposal was small and unrepresentative.

This report is no more than a modest contribution toward the knowledge of the Tertiary mollusks of Trinidad. Much additional work is needed to give range charts of species, because the inventory of Trinidadian Tertiary mollusks is far from complete. Rich faunas from several formations or members are practically unstudied or incompletely described, e.g. the faunas of the Brasso Formation, the Manzanilla Formation, and the Gransauil Clay Member, and the Chickland Clay Member, both of the Springvale Formation, to mention a few. More detailed information on the formations, members referred to in this paper, and on the non-molluscan paleontology is contained in a manuscript on the stratigraphy of Trinidad by H. G. Kugler.

All the material mentioned, described, and figured in this report is deposited at the Naturhistorisches Museum, Basel, Switzerland, or at the U.S. National Museum, Washington, D. C.



Text-figure 1. Index map showing general areas of fossil localities.

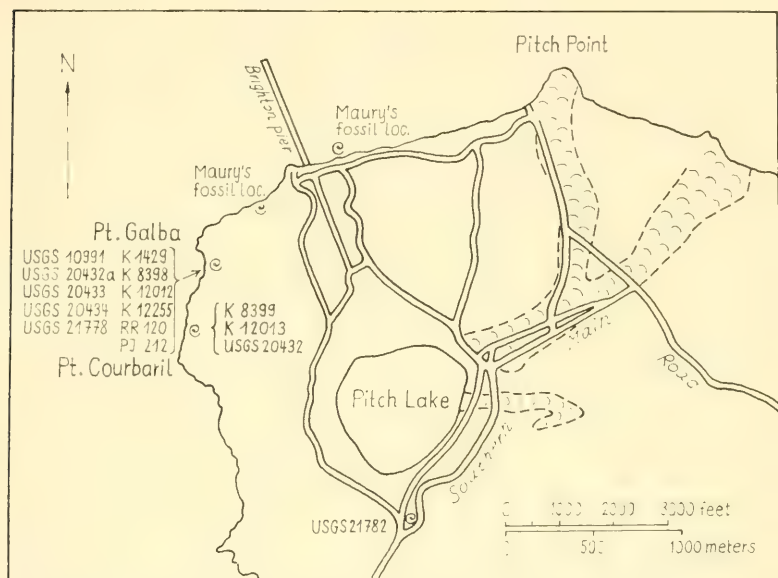
LOCALITY DATA

MELAJO RIVER AREA

All the fossil localities of this area and referred to in this report are plotted in Text-figure 2. The material has been collected by A. G. Hutchinson, E. Lehner, H. G. Kugler, K. Rohr, and the writer. The material in the U.S. National Museum carries the USGS locality numbers 18399, 18411, 18634, and 21178.

The Melajo beds are situated on the south slope of the Northern Range of Trinidad to the west of Matura Bay. They dip about 5 degrees to south and rest transgressively on the phyllites of the Northern Range with a basal conglomerate of about 1 m thickness. This conglomerate consists of small quartz and phyllite pebbles and grades into a 1.5 m thick limestone with large mollusks. The limestone is overlain by a bed of coarse sand of about 1 m thickness. Above the sand follows the typical blue, yellowish weathering Melajo Clay and silty clay with occasional sandy layers. The total thickness of the Melajo Clay Member is about 200 feet. In the type area it is unconformably overlain by Pleistocene sand and gravel deposits.

Pitch Lake, near Mile Post 56 $\frac{3}{4}$ (now 49 $\frac{3}{4}$) (Maury, 1912, p. 27). This last locality is the same as USGS 21782.



Text-figure 3. Point Courbaril area showing fossil localities.

MATURA

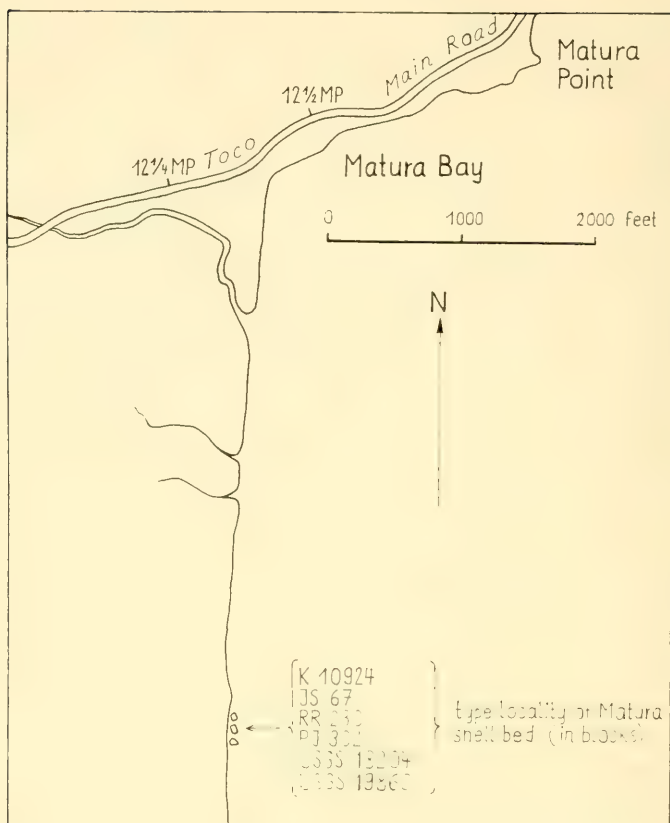
The geographic location of the Matura shell bed is shown in Text-figure 4. The type locality of the Matura Sand and Clay Member of the Talparo Formation (Kugler MS) is made up of a number of slipped blocks situated on the coast south of Matura Bay. These blocks consist of highly limonitic, brown coquina with intercalations of clay and silt. For the greatest part the shells are worn by wave action. According to Kugler (MS) the Matura beds unconformably overlap the Melajo beds.

All the collections from the Matura shell bed (K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860) have been taken from these blocks.

COMPOSITION OF THE FAUNAS

A total of 325 species is considered in this report. The number of species in the three classes is as follows:

Scaphopoda 4



Text-figure 4. Geographic location of Matura shell bed.

Pelecypoda	115
Gastropoda	206

The following is a list of the species mentioned. Their occurrence in the different stratigraphic units is indicated.

Melajo Point
River Courbaril Matura

Scaphopoda

Dentalium (Dentalium) divulgatum, n.sp.	o	o	
Dentalium (Dentalium) species			o
Dentalium (Graptacme) cf. amaliense Henderson			o
Dentalium (Laevidentalium ?) species			o

Melajo Point
River Courbaril Matura

Pelecypoda

<i>Nucula</i> (<i>Lamellinucula</i>) <i>vieta</i> Guppy			o
<i>Nucula</i> (<i>Lamellinucula</i>) <i>baccata</i> Guppy	o	o	o
<i>Nuculana</i> (<i>Saccella</i>) <i>ludificans</i> , n.sp.	o	o	
<i>Nuculana</i> (<i>Saccella</i>) <i>perlepada</i> (Guppy)			o
<i>Calorhadia</i> (<i>Calorhadia</i>) <i>solivaga</i> , n.sp.	o		
<i>Adrana</i> <i>perprotracta</i> (Dall) ?	o	o	
<i>Arca</i> (<i>Arca</i>) <i>zebra zebra</i> (Swainson)			o
<i>Arca</i> (<i>Arca</i>) <i>imbricata imbricata</i> Bruguière		o	o
<i>Barbatia</i> (<i>Barbatia</i>) <i>candida</i> (Helbling)			o
<i>Barbatia</i> species	o		
<i>Barbatia</i> (<i>Acar</i>) <i>domingensis</i> (Lamarck)			o
<i>Barbatia</i> (<i>Fugleria</i> ?) <i>millifila latrinidadiis</i> Maury			o
<i>Arcopsis</i> <i>adamsi</i> (Dall)	o		o
<i>Anadara</i> (<i>Anadara</i>) aff. <i>inaequilateralis</i> (Guppy)	o	o	
<i>Anadara</i> (<i>Cunearca</i>) <i>brasiliansa</i> (Lamarck)		o	o
<i>Anadara</i> (<i>Cunearca</i>) aff. <i>filicata</i> (Guppy)	o	o	
<i>Anadara</i> (<i>Scapharca</i> ?) <i>sanctidavidis</i> (Maury)			o
<i>Anadara</i> (<i>Scapharca</i>) <i>placata</i> , n.sp.	o		
<i>Lunarca</i> <i>billingsiana</i> (Maury)		o	o
<i>Noetia</i> (<i>Noetia</i>) <i>sheldoniana</i> (Maury)	o	o	o
<i>Noetia</i> (<i>Eontia</i>) <i>centrota</i> (Guppy)	o	o	o
<i>Glycymeris</i> (<i>Glycymeris</i>) cf. <i>undata</i> (Linné)			o
<i>Tucetona</i> cf. <i>pectinata</i> (Gmelin)			o
<i>Brachydontes</i> (<i>Brachydontes</i>) species		o	o
<i>Modiolus</i> cf. <i>americanus</i> (Leach)			o
<i>Atrina</i> species	o		
<i>Plicatula</i> <i>gibbosa</i> Lamarck			o
<i>Pecten</i> (<i>Pecten</i>) <i>archon</i> Maury	o		
<i>Aequipecten</i> (<i>Plagiectenium</i>) cf. <i>gibbus</i> (Linné)			o
<i>Aequipecten</i> (<i>Plagiectenium</i>) <i>demiurgus</i> (Dall)	o		
<i>Aequipecten</i> (<i>Plagiectenium</i>) <i>maturensis</i> (Maury)			o
<i>Aequipecten</i> (<i>Plagiectenium</i>) cf. <i>maturensis</i> (Maury)	o		
<i>Aequipecten</i> (<i>Plagiectenium</i>) <i>rutamensis</i> , n.sp.			o
<i>Aequipecten</i> (<i>Plagiectenium</i>) species		o	
<i>Cyclopecten</i> species	o		
<i>Ostrea</i> species		o	
<i>Crassostrea</i> cf. <i>virginica</i> (Gmelin)		o	o
<i>Lopha</i> <i>messor</i> (Maury)	o		
<i>Anomia</i> <i>simplex</i> d'Orbigny	o	o	o
<i>Eucrassatella</i> <i>trinitaria</i> (Maury)	o		
<i>Crassinella</i> <i>martinicensis</i> (d'Orbigny)			o
<i>Crassinella</i> <i>guppyi</i> (Dall)	o	o	
<i>Carditamera</i> (<i>Carditamera</i>) <i>guppyi</i> (Dall)			o
<i>Carditamera</i> (<i>Carditamera</i>) species	o	o	
<i>Carditamera</i> (<i>Byssomera</i>) aff. <i>affinis</i> (G. B. Sowerby I)		o	
<i>Condylocardia</i> <i>guppyi</i> (Maury)			o
<i>Lucina</i> (<i>Lucina</i>) cf. <i>pectinata</i> (Gmelin)			o
<i>Lucina</i> (<i>Luciniscia</i>) <i>roigi</i> (Maury)	o	o	o
<i>Chama</i> cf. <i>macrophylla</i> Gmelin		o	
<i>Chama</i> spec. ind.			o
<i>Pseudochama</i> aff. <i>caloosana</i> (Dall)			o
<i>Trachycardium</i> (<i>Dallocardia</i>) <i>sanctidavidis</i> (Maury)	o	?	o
<i>Trigoniocardia</i> (<i>Trigoniocardia</i>) <i>maturensis</i> (Dall)	o	o	o

Melajo Point
River Courbaril Matura

Trigoniocardia (Trigoniocardia) melajoensis, n.sp.	o		
Trigoniocardia (Trigoniocardia) cf. caboblanquensis Weisbord	o		?
Laevicardium cf. laevigatum (Linné)	o		
Dosinia (Dosinia) grandis Nelson	o		
Dosinia (Dosinia) species	o	o	
Cyclinella aff. tenuis (Recluz)		o	
Cyclinella (?) species	o		
Tivela (Tivela) austeniana (Maury)			o
Macrocallista maculata (Linné)	o		
Pitar (Lamelliconcha) circinatus (Born)	o	o	o
Pitar (Lamelliconcha) labreanus (Maury)	o		
Chione (Chione) cancellata (Linné)	?		o
Chione (Nioche) veatchiana Maury		o	o
Chione (Lirophora) caroniana Maury	o		
Chione (Lirophora) species			o
Chione (Lirophora) sanctidavidis Maury	o	o	o
Anomalocardia brasiliana (Gmelin)			o
Mactra (Micromactra) cf. maracaibensis H. K. Hodson	o		o
Mulinia species		o	o
Moerella (Moerella) elinguis, n.sp.	o	o	
Eurytellina punicea (Born) ?	cf.	o	?
Eurytellina melajoensis, n.sp.	o	o	
Eurytellina ? oligoscissulata, n.sp.	o	o	
Merisca trinidadensis, n.sp.	o		
Tellidora species	o		
Strigilla (Strigilla) carnaria (Linné) ?		o	o
Strigilla (Pisostrigilla) pisiformis (Linné)			o
Strigilla (Pisostrigilla ?) species		o	
Macoma (Psammacoma) species A	o		
Macoma (Psammacoma) species B		o	
Psammotreta galbana, n.sp.		o	
Apolymetis trinitaria (Dall)	o		
Temnoconcha aff. brasiliana (Dall)	o	o	
Semele proficua (Pulteney)		o	o
Semele purpurascens (Gmelin)		o	o
Semele laevis costaricensis Olsson	o	o	
Semele claytoni couvensis Maury	o		
Semele aff. antierocosta Vokes	o	o	o
Abra cf. acqualis (Say)		o	
Abra ? species			o
Cumingia galbensis, n.sp.		o	
Donax striatus Linné ?		o	o
Donax fabagelloides Guppy			o
Donax brightonensis, n.sp.		o	
Donax (Machaerodonax ?) species			o
Tagelus (Tagelus) plebeius (Lightfoot)		o	
Tagelus (Mesopleura) cf. divisus (Spengler)		o	
Tagelus (Mesopleura ?) mansfieldi (Vokes)	o		
Pleuropygia caroniana (Maury)	o		
Solen (Solen) species	o		
Solen (Solen) obliquus Spengler		o	o
Caryocorbula (Caryocorbula) helenae (Maury)	o	o	
Caryocorbula (Caryocorbula) species	o	o	o

	Melajo River	Point Courbaril	Matura
<i>Juliacorbula aequivalvis</i> (Philippi)	o	o	o
<i>Notocorbula islatrinitatis</i> (Maury)	o		
<i>Notocorbula</i> species	o		
<i>Notocorbula</i> aff. <i>disparilis</i> (d'Orbigny)			o
<i>Tenuicorbula melajoensis</i> , n.sp.	o		
<i>Tenuicorbula</i> aff. <i>melajoensis</i> , n.sp.			o
<i>Pholas</i> species		o	
<i>Martesia striata</i> (Linné) ?		o	
<i>Pandora</i> species	o		
<i>Gastropoda</i>			
<i>Diodora cayenensis</i> (Lamarck)		o	o
<i>Diodora</i> (?) species			o
<i>Acmaea</i> species			o
<i>Calliostoma decipiens</i> (Guppy)	o		o
<i>Calliostoma laticarinatum</i> (Guppy)			o
<i>Calliostoma caronianum</i> Maury	o		
<i>Calliostoma plicomphalus</i> (Guppy)			o
<i>Calliostoma olssoni</i> Maury	o	o	o
<i>Microgaza oblita</i> , n.sp.			o
<i>Astraea</i> (<i>Astralium</i>) cf. <i>brevispina</i> (Lamarck)			o
<i>Parviturbo maturensis</i> , n.sp.			o
<i>Nerita</i> (<i>Nerita</i>) <i>exuvioides</i> Trechmann ?	o		
<i>Neritina</i> (<i>Vitta</i>) cf. <i>virginea</i> (Linné)	o	o	o
<i>Rissoina</i> (<i>Rissoina</i>) species		o	o
<i>Feinostoma</i> (<i>Pseudorotella</i>) <i>nugax</i> , n.sp.	o		
<i>Teinostoma</i> (<i>Pseudorotella</i>) <i>spretum</i> , n.sp.	o		
<i>Teinostoma</i> (<i>Aepystoma</i>) <i>caroniense</i> Maury	o	o	
<i>Teinostoma</i> (<i>Aepystoma</i>) <i>melajoense</i> , n.sp.	o		
<i>Cochliolepis pluscula</i> , n.sp.	o		
<i>Cyclostremiscus</i> (<i>Ponocyclus</i>) <i>pentagonus</i> (Gabb)	o		
<i>Cyclostremiscus</i> (<i>Ponocyclus</i>) species			o
<i>Solariorbis</i> (subgenus ?) <i>marginatus</i> (Guppy)	?		o
<i>Caecum</i> species A	o		
<i>Caecum</i> species B	o		
<i>Caecum</i> species C	o		
<i>Caecum</i> species D		o	
<i>Caecum</i> species E			o
<i>Turritella</i> (<i>Broderiptella</i>) <i>bifastigata cartagenensis</i> Pilsbry and Brown		o	
<i>Turritella</i> (<i>Broderiptella</i>) aff. <i>mimetes</i> Brown and Pilsbry	o		
<i>Turritella</i> (<i>Broderiptella</i>) <i>planigyrate</i> Guppy	o		
<i>Turritella</i> (<i>Broderiptella</i>) aff. <i>planigyrate</i> Guppy			o
<i>Turritella</i> (<i>Bactrospira</i>) species			o
<i>Springvaleia leroyi</i> (Guppy)	o		
<i>Vermicularia spirata</i> (Philippi) ?			o
<i>Vermicularia</i> (?) <i>trilineata</i> (Guppy)			o
<i>Serpulorbis decussatus</i> (Gmelin)		o	o
<i>Petalocochus sculpturatus alcimus</i> Mansfield	o		
<i>Petalocochus</i> cf. <i>floridanus</i> Olsson and Harbison			o
<i>Batillaria</i> species	o		
<i>Cerithium</i> (subgenus ?) <i>harrisi</i> Maury	o	o	cf.
<i>Bittium</i> (<i>Bittiolium</i>) <i>fretense</i> , n.sp.		o	
<i>Cerithiopsis</i> (<i>Cerithiopsis</i>) species			o

Melajo Point
River Courbaril Matura

Cerithiopsis (subgenus ?) emersoni (C. B. Adams)			o
Cerithiopsis (subgenus ?) species			o
Seila cf. adamsi (H. C. Lea)			o
Modulus carchedonius (Lamarck)			o
Architectonica (Architectonica) nobilis nobilis Röding	o		o
Architectonica (Pseudotorinia) melajoensis, n.sp.	o		
Architectonica (Pseudotorinia) guppyi, n.sp.			o
Architectonica (Pseudotorinia) semidecussata (Guppy)			o
Architectonica (Pseudotorinia) cf. semidecussata (Guppy)		o	
Mathilda species A	o		?
Mathilda species B		o	
Triphora guttata (Guppy)		o	
Triphora species	o		
Epitonium (Epitonium) albidum (d'Orbigny)			o
Epitonium (Epitonium) aff. foliaceicostum (d'Orbigny)	o	o	
Epitonium (Epitonium) humphreysi (Kiener) ?		o	
Epitonium (Epitonium) maturense, n.sp.			o
Epitonium (Asperiscala) cf. multistriatum (Say)			o
Epitonium (Asperiscala) cf. candeanum (d'Orbigny)			o
Epitonium (Asperiscala) rohri, n.sp.	o	o	
Epitonium (Asperiscala) aff. sericifilum (Dall)			o
Eulima clavata (Guppy)			o
Eulima species A	o	?	
Balcis egregia (Guppy)	o		
Balcis species A			o
Niso grandis Gabb ?	o		
Niso species			o
Fossarus (Iselica) anomalus (C. B. Adams) ?			o
Hipponix cf. antiquatus (Linné)			o
Cheilea cf. equestris (Linné)			o
Crepidula (Crepidula) cf. maculosa Conrad	o		
Crepidula sp.	o		o
Crepidula plana Say	o		
Crepidula (Bostrycapulus) aculeata (Gmelin)			o
Calyptraea centralis (Conrad)	o	o	o
Trochita radians (Lamarck)			o
Crucibulum (Crucibulum) subsutum Guppy			o
Crucibulum (Crucibulum) piliferum Guppy	cf.	cf.	o
Erato maugeriae Gray			o
Trivia (Pusula) radians orientalis (Schilder)			o
Cypraea species			o
Cypraea (Erosaria) aliena (Schilder)			o
Neosimnia cf. uniplicata (G. B. Sowerby II)			o
Natica (Naticarius) canrena (Linné)	o		
Natica (Naticarius) aff. canrena (Linné)	o	o	o
Tectonatica pusilla (Say)			o
Polinices stanislasmeyneri Maury	o		
Polinices species			o
Cymatium species	o		
Colubraria species	o		
Bursa (Bursa) aff. thomae (d'Orbigny)	o		
Bursa (Marsupina) bufo (Bruguère)			o
Malea species	o		
Murex (Murex) chrysostoma G. B. Sowerby I	o		

	River Melajo	Courbaril Point	Matura
<i>Murex</i> (<i>Phyllonotus</i>) cf. <i>pomum</i> Gmelin	o		o
<i>Murex</i> (<i>Chicoreus</i>) cf. <i>brevifrons</i> Lamarck	o	o	
<i>Eupleura</i> <i>lehneri</i> , n.sp.	o		
<i>Typhis</i> (<i>Typhinellus</i>) cf. <i>quadratus</i> Hinds			o
<i>Typhis</i> (subgenus ?) species	o		
<i>Calotrophon</i> (?) <i>hutchisoni</i> , n.sp.	o		
<i>Risomurex</i> <i>galbensis</i> , n.sp.		o	
<i>Thais</i> (<i>Stramonita</i>) cf. <i>haemostoma</i> (Linné)		o	o
<i>Thais</i> (<i>Stramonita</i>) species A	o		
<i>Cymia</i> <i>brightoniana</i> Maury		o	
<i>Cymia</i> species	o		
<i>Parametaria</i> <i>prototypus</i> (Guppy)	o		
<i>Parametaria</i> <i>rutschi</i> , n.sp.			o
<i>Anachis</i> (<i>Anachis</i>) <i>asphaltoda</i> (Maury)		o	o
<i>Anachis</i> (<i>Anachis</i>) species			o
<i>Anachis</i> (<i>Costoanachis</i>) <i>obesa</i> (C. B. Adams)	o	o	o
<i>Anachis</i> (<i>Costoanachis</i>) <i>fraudans</i> , n.sp.	o		
<i>Zanassarina</i> species			o
<i>Aesopus</i> <i>peculiaris</i> (Guppy)			o
<i>Aesopus</i> aff. <i>metcalfei</i> Reeve			o
<i>Strombina</i> (subgenus ?) <i>melaioensis</i> , n.sp.	o		
<i>Strombina</i> (<i>Sincola</i>) <i>crassilabrum</i> (Guppy)	o	o	o
<i>Strombinophos</i> <i>perdoctus</i> , n.sp.	o		
<i>Strombinophos</i> species			o
<i>Buccinid</i> indet.		o	
<i>Cantharus</i> (subgenus ?) species A	o		
<i>Hanetia</i> <i>semiglobosa</i> (Guppy)	o		
<i>Calophos</i> <i>rohri</i> (Rutsch)	o		
<i>Metaphos</i> (?) species		o	
<i>Metula</i> aff. <i>cancellata</i> Gabb	o		
<i>Pallacera</i> species A	o		
<i>Pallacera</i> cf. <i>guadelupensis</i> (Petit de la Saussaye)			o
<i>Nassarius</i> (<i>Phrontis</i>) <i>vibex</i> (Say)		o	
<i>Nassarius</i> (<i>Uzita</i>) <i>trinitatensis</i> , n.sp.	o	o	
<i>Nassarius</i> (<i>Uzita</i>) cf. <i>albus</i> (Say)			o
<i>Nassarius</i> (<i>Uzita</i>) species A	o		
<i>Nassarius</i> (subgenus ?) <i>galbanus</i> , n.sp.		o	
<i>Melongena</i> <i>melongena</i> (Linné)		o	
<i>Latirus</i> (<i>Polygona</i>) cf. <i>infundibulum</i> (Gmelin)	o		
<i>Fasciolaria</i> cf. <i>tulipa</i> (Linné)			o
<i>Fasciolaria</i> (<i>Pleuroploca</i>) <i>turamensis</i> , n.sp.			o
<i>Fusinus</i> species	o		
<i>Fusinus</i> cf. <i>henekeni</i> (G. B. Sowerby I)			o
<i>Oliva</i> (<i>Oliva</i>) <i>couvana</i> Maury	o		
<i>Jaspidella</i> <i>sanctidominici</i> (Maury)	o		
<i>Olivella</i> (<i>Olivella</i>) species			o
<i>Olivella</i> (<i>Dactylidia</i>) aff. <i>mutica</i> (Say)	o		
<i>Olivella</i> (<i>Niteoliva</i>) cf. <i>verreauxi</i> (Ducros)			o
<i>Olivella</i> (<i>Minioliva</i>) <i>fundarugata</i> Weisbord	o	o	
<i>Ancilla</i> (<i>Eburna</i>) <i>caroniana</i> Maury	o		
<i>Cancilla</i> cf. <i>sanctifrancisci</i> (Maury)	o		
<i>Scabricola</i> <i>nodulosa</i> (Gmelin)			o
<i>Conomitra</i> species A	o		

	River Melajo	Courbaril Point	Matura
<i>Turbinella riosecana</i> (H. K. Hodson)	o		
<i>Prunum</i> (<i>Prunum</i>) <i>dallianum</i> (Maury)		o	?
<i>Prunum</i> (<i>Egouena</i>) <i>springvalense</i> (Maury)	o		
<i>Prunum</i> (<i>Egouena</i>) <i>calypsonis</i> (Maury)	o		
<i>Volvarina</i> (?) species A	o		
<i>Volvarina</i> (?) species B		o	o
<i>Persicula</i> (<i>Rabicea</i>) <i>couviana</i> (Maury)	o		
<i>Persicula</i> (<i>Rabicea</i>) cf. <i>interruptolineata</i> (Megerle von Mühlfeld)			o
<i>Bullata maiae</i> (Maury)	o		
<i>Bullata maturensis</i> , n.sp.		o	o
<i>Cancellaria</i> (<i>Euclia</i>) <i>montserratensis</i> Maury	o		
<i>Cancellaria</i> (<i>Euclia</i>) cf. <i>codazzii</i> Anderson	o		
<i>Cancellaria</i> (<i>Narona</i>) <i>semota</i> , n.sp.	o		
<i>Cancellaria</i> (<i>Charcolleria</i>) species	o		
<i>Trigonostoma</i> (<i>Emmonsella</i>) species	o		
<i>Conus springvaleensis</i> Mansfield	o		
<i>Conus couvaensis</i> Vokes	o		
<i>Conus</i> species			o
<i>Polystira</i> species A			o
<i>Polystira</i> species B	o		
<i>Carinodrillia meraca</i> , n.sp.	o		
<i>Crassispira</i> (<i>Crassispira</i>) cf. <i>caroniana</i> (Maury)	o		
<i>Crassispira</i> (<i>Crassispira</i>) <i>faceta</i> , n.sp.			o
<i>Crassispira</i> (<i>Crassispirella</i>) <i>ritanida</i> (Mansfield)			o
<i>Agladrillia</i> (?) <i>lassula</i> , n.sp.	o		
<i>Lepicythara disclusa</i> , n.sp.	o		
<i>Ithycythara hilaris</i> , n.sp.	o		
<i>Ithycythara</i> species		o	
<i>Adelocythara</i> (?) <i>micropleura</i> (Guppy)			o
<i>Glyptaesopus</i> species			o
<i>Miraclathurella ralla</i> , n.sp.	o		
<i>Glyphostoma sculptile</i> , n.sp.	o		
<i>Strioterebrum</i> cf. <i>gatumense</i> (Toula)	o		
<i>Strioterebrum</i> aff. <i>laevifasciola</i> (Maury)	o	?	
<i>Strioterebrum</i> aff. <i>baculiforme</i> (Pilsbry and Johnson)	o		
<i>Strioterebrum</i> species			o
<i>Hastula</i> aff. <i>hastata</i> (Gmelin)			o
<i>Pyramidella</i> (<i>Longchaeus</i> ?) species A			o
<i>Pyramidella</i> (<i>Callolongchaeus</i>) aff. <i>jamaicensis</i> Dall	o		
<i>Pyramidella</i> (<i>Callolongchaeus</i>) cf. <i>diademata</i> Maury	o		
<i>Triptychus</i> (<i>Peristichia</i>) species			o
<i>Eulimella</i> (<i>Eulimella</i>) species A	o		
<i>Eulimella</i> (<i>Ebalina</i>) <i>mitis</i> , n.sp.	o		o
<i>Turbonilla</i> species A	o		o
<i>Turbonilla</i> species B	o		
<i>Turbonilla</i> species C			o
<i>Turbonilla</i> species D	o		
<i>Turbonilla</i> species E	o		
<i>Odostomia canaliculata</i> C. B. Adams ?			o
<i>Odostomia</i> (<i>Salassia</i> ?) species			o
<i>Rictaxis</i> species	o		
<i>Acteocina canaliculata</i> (Say) ?	o		o
<i>Cylichnella altera</i> , n.sp.	o		

	River Melajo	Courbaril Point	Matura
Cylichnella species		o	
Sulcoretusa aff. sulcata (d'Orbigny)	o		
Rhizorus species A			o
Rhizorus species B	o		

MELAJO FAUNA

The fauna occurring in the Melajo Clay Member consists of 168 species of mollusks (1 scaphopod, 57 pelecypods, 110 gastropods). It is of about the same size as that of the Savaneta Glauconitic Sandstone Member. Rutsch (1942) cited 153 species from the latter member, but Woodring (1958, p. 169) stated that there are about 20 additional species. It must be remembered that much more collecting has been done in the Savaneta Glauconitic Sandstone Member than in the Melajo Clay and this for two reasons: first the fossiliferous beds at Springvale Quarry and along the Savaneta River have been known for a much longer time than the fossiliferous Melajo Clay; second the Melajo River area is not so easily accessible as the outcrops of the Savaneta Glauconitic Sandstone Member. It, therefore, can be expected that further collecting in the Melajo Clay will yield many additional species.

The Melajo fauna can be divided into two assemblages: one occurring in the limestone and coarse sand near the base of the Melajo Clay Member, the other one in the overlying clay and silty clay. The difference of the two assemblages is facies controlled; in terms of age, or difference in age, negligible, for the Melajo Clay Member is only about 200 feet thick. The basal assemblage represents a typical, tropical, near-shore fauna, whereas the overlying assemblage points to a deeper environment.

Despite the presence of *Nerita* (*Nerita*) *exuvioides* Trechmann ?, *Neritina* (*Vitta*) cf. *virginica* (Linné), *Batillaria* species, and *Cerithium* (subgenus ?) *harrisi* Maury, the brackish water influence must have been slight in the Melajo fauna. All the species mentioned are represented by one or a few specimens only. The Melajo fauna as a whole indicates normal marine conditions with an average salinity.

Associated with the mollusks are a few corals, Bryozoa, and spines of echinoderms. Van den Bold (1963, p. 364) listed 31 species of ostracods from the type locality of the Melajo Clay (KR 11862

= USGS 18399) and two species from KR 11863 (= USGS 18634). The foraminiferal assemblages from several localities in the Melajo River area have been studied by J. B. Saunders (private report). Most of these faunas are poor. The richest foraminiferal fauna is found at the type locality of the Melajo Clay (USGS 18399), from where Saunders listed 61 species. Most of these forms are benthonic. The planktonic species include *Globigerina bulloides* and *Globigerinoides rubra*.

COURBARIL FAUNA

The fauna of the Courbaril Sand and Clay Member consists of 96 species (1 scaphopod, 55 pelecypods, 40 gastropods). The fossils are generally well preserved but not so well as those from the Melajo Clay. Many specimens show adhering asphalt which derived from the asphalt flows from the Pitch Lake, spreading over the sediments during the deposition of the Courbaril beds. The Courbaril assemblage as a whole, the rock clinger *Diodora cayenensis*, and the intertidal genus *Brachydontes* point to a near-shore environment. The brackish water influence was probably higher than during deposition of the Melajo Clay. *Neritina* (*Vitta*) cf. *virginica* is represented by a few specimens, but *Cerithium* (subgenus ?) *harisi* occurs in great numbers. Boring mollusks are represented by a species of *Pholas* and *Martesia striata* (Linné)?

Associated with the mollusks are a few crab claws, corals, fish teeth, and scarce Foraminifera. Van den Bold (1963, pp. 363, 368) described and listed the Ostracoda from the Courbaril beds.

MATURA FAUNA

The fauna from the Matura shell bed consists of 160 species of mollusks (3 scaphopods, 58 pelecypods, 99 gastropods). Guppy (1864, p. 40) considered the Matura fauna to be a dwarfed one and concluded "that there is some likelihood that glacial influences had a share in the modification of the fauna of the Matura beds". This, of course, is not the case. The Matura fauna is a typical, tropical, near-shore assemblage. Although there is a large number of small forms, large species are present as well, e.g. *Arca zebra*, *Anadara brasiliensis*, *Lunarcia billingsiana*, a large specimen of *Noctia sheldoniana*, *Ostrea* cf. *virginica*, *Lucina* cf. *pectinata*, *Cypraea* species, *Bursa bufo*, *Murex* cf. *pomum*, *Fasciolaria turamensis*, *Fusinus* cf. *henekeni*, and *Bullata maturensis*. As suggested

by Rutsch (1942, private report) it is more likely that the Matura fossils have been sorted mechanically. This view is supported by the fact that a large percentage of the Matura specimens is rolled, and that there is a relatively high number of broken shells.

The postulation of a near-shore environment of the Matura fauna is supported by the presence of the rock clingers *Diodora cayenensis*, *Diodora* (?) species, *Acmaea* species, and the intertidal genus *Brachydontes*. The brackish water influence must have been low during deposition of the Matura beds. It is indicated only by a few specimens identified as *Neritina* (*Vitta*) cf. *virginica* and *Cerithium* cf. *harrisi*. The Matura fauna contains a surprisingly high number of Calyptraeidae, the species of which attach themselves to stones.

Associated with the mollusks are several species of corals, Bryozoa, lots of spines of echinoderms. Berry (1935, p. 430) described an ophiuran from Matura. In addition there are fish teeth, otoliths, *Balanus*, and ostracods. J. B. Saunders (private report) listed 31 species of Foraminifera from the type locality of the Matura beds.

AGES

The discussion on the relative ages of the three faunas described in this report is limited by the time interval between the Savaneta Glauconitic Sandstone Member of the Springvale Formation at the bottom and the Recent fauna on top. The relative age assignments of the three faunas is based on the affinities of each to the extremes mentioned above and their mutual relationships.

The upper (late) Miocene age of the Savaneta Glauconitic Sandstone Member of the Springvale Formation has never been contradicted since the discovery of its molluscan fauna: Guppy (1867), Maury (1925), Mansfield (1925), Vokes (1938), Rutsch (1942), Woodring (1966). This view is supported by the study of the ostracods (van den Bold, 1963). The affinities of this fauna to faunas of comparable age outside Trinidad have been pointed out by Rutsch (1942).

The percentage figures given on the following pages have to be taken, of course, *cum grano salis*.

MELAJO FAUNA

As mentioned above the Melajo fauna can be divided into two

assemblages: one collected from the limestone and sand near the base of the Melajo Clay, the other one from the overlying clay and silty clay. The lower assemblage consists of 71 species, 40 of which (or more than 56%) are identical or closely related with species occurring in the Savaneta Glauconitic Sandstone Member. They are:

- Pecten (Pecten) archon* Maury
- Aequipecten (Plagioctenium) demiurgus* (Dall)
- Anomia simplex* d'Orbigny
- Eucrassatella trinitaria* (Maury)
- Trigoniocardia (Trigoniocardia) melajoensis*, n.sp.
- Dosinia (Dosinia) grandis* Nelson
- Macrocallista maculata* (Linné)
- Chione (Lirophora) caroniana* Maury
- Macoma (Psammacoma) species A*
- Apolymetis trinitaria* (Dall)
- Semele claytoni couvensis* Maury
- Semele* aff. *anteriocosta* Vokes
- Tagelus (Mesopleura?) mansfieldi* (Vokes)
- Pleiorytis caroniana* (Maury)
- Notocorbula islatrinitatis* (Maury)
- Calliostoma caronianum* Maury
- Turritella (Broderiptella) planigyrate* Guppy
- Springvaleia leroyi* (Guppy)
- Petalocochnus sculpturatus alcimus* Mansfield
- Architectonica (Architectonica) nobilis nobilis* Röding
- Balcis egregia* (Guppy)
- Calyptrea centralis* (Conrad)
- Natica (Naticarius) canrena* (Linné)
- Polinices stanislasmeynieri* Maury
- Parametaria prototypus* (Guppy)
- Hanetia semiglobosa* (Guppy)
- Calophos rohri* (Rutsch)
- Latirus (Polygona) cf. infundibulum* (Gmelin)
- Oliva (Oliva) couvana* Maury
- Jaspidella sanctidominici* (Maury)
- Ancilla (Eburna) caroniana* Maury
- Cancilla cf. sanctifrancisci* (Maury)
- Turbinella riosecana* (H. K. Hodson)
- Prunum (Egouena) springvalense* (Maury)
- Prunum (Egouena) calypsonis* (Maury)
- Persicula (Rabicea) couviana* (Maury)
- Cancellaria (Euclia) montserratensis* Maury
- Conus springvaleensis* Mansfield
- Conus couvaensis* Vokes
- Lepicythara disclusa*, n.sp.

The lower assemblage of the Melajo Clay and the mollusks from the Savaneta Glauconitic Sandstone Member must have lived under similar conditions and at about the same time. This, at least, would be the most reasonable explanation for the high number of species common to both faunas.

The upper Melajo assemblage has a far smaller number of species in common with the Savaneta fauna. This is principally due to different facies and much less so to a difference in age. The upper Melajo assemblage lived in deeper water than the Savaneta fauna. The entire Melajo fauna has about 32% of its species in common with the Savaneta fauna.

The lower Melajo assemblage is, therefore, correlated with the late Miocene Savaneta Glauconitic Sandstone Member of the Springvale Formation. The upper Melajo assemblage probably lived at the same time as the Savaneta fauna but in deeper water. Based on the fact that it rests on the lower assemblage it may be slightly younger than the Savaneta fauna.

Including the species that have been identified by means of the *nomenclatura aperta* there are 20 Melajo species (or about 12% of the total Melajo fauna) still living in the Recent fauna. The corresponding figure for the Savaneta fauna is 11%.

The Melajo fauna has 41 species (or a little more than 24%) in common with the Courbaril fauna; 31 species (or a little more than 18% of the Melajo fauna) occur in the Melajo and the Matura faunas. This figure shows that the Melajo fauna is more closely related to the Courbaril fauna than to the fauna from Matura.

COURBARIL FAUNA

Maury (1912, p. 27) attributed a late Oligocene age to the Courbaril fauna, but Maury (1925, p. 17) called it upper Pliocene. On the other hand van den Bold (1963, p. 367) proposed a correlation of the Courbaril beds with the Melajo Clay Member of the Springvale Formation. The study of the mollusks now available does not support any of these views.

The Courbaril fauna includes 29 species (or about 30%) still living in the Recent fauna. This percentage is considerably higher than the corresponding figure for the Melajo fauna (about 12%). This circumstance alone is reason to believe that there was a considerable time span between the deposition of the Melajo beds and that of the Courbaril beds. On the other hand the percentage of still living species occurring in the Matura fauna is more than 37. In terms of age the Courbaril fauna, therefore, is older than the Matura fauna, and according to its percentage of still living species

it is more closely related to the Matura fauna than to the Melajo fauna.

This relation, however, is not well supported by the affinities of the Courbaril fauna to the other faunas studied. There are 41 species (or almost 43%) in the Courbaril fauna occurring in the Melajo fauna as well; and 40 species (or a little less than 42%) common to the Courbaril and Matura faunas. This figure is not too significant, because the Courbaril fauna is the least complete fauna studied. The corresponding percentages of the Matura fauna, however, again show that it is more closely related to the Courbaril fauna than to the Melajo fauna (see below).

For reasons becoming evident below the Courbaril fauna is considered to be of early Pliocene age.

MATURA FAUNA

The Matura shell bed has variously been attributed to the Pliocene or Pleistocene. Guppy (1864, 1867, 1874) considered it to be Pliocene. Maury (1925, p. 17) correlated the Matura fauna with that of Point Courbaril, which she thought is of upper Pliocene age. Kugler (1936, p. 1449) indicated a Pleistocene age, but Kugler (1953, p. 55) attributed a late Pliocene age to the Matura Formation. Rutsch (1942, private report) pleaded in favour of a Pliocene age, and Woodring (1966, p. 432) called the Matura fauna early Pliocene.

Including the species that have been identified by means of the *nomenclatura aperta* there are 60 Matura species still living in the Recent fauna. This number corresponds to a percentage of more than 37. The Matura fauna has 31 species (or more than 19%) in common with the Melajo fauna; and 40 species (or 25%) in common with the Courbaril fauna. The Matura fauna is thus more closely related to the Courbaril fauna than to the Melajo fauna, but it is closer to the Recent fauna than to the Courbaril fauna.

For reasons given below the Matura fauna seems to be of early Pliocene age.

AFFINITIES TO EASTERN PACIFIC RECENT GENERA, SUBGENERA, AND SPECIES

In application of the stimulating paper by Woodring (1966)

the genera and subgenera extinct in the Western Atlantic but living in Eastern Pacific waters are listed. This list includes genera and subgenera occurring in the three faunas studied but does not pretend to be complete, although it contains two genera not tabulated by Woodring. They are:

In the Melajo fauna	In the Courbaril fauna	In the Matura fauna
<i>Noetia</i> (<i>Noetia</i>)	<i>Noetia</i> (<i>Noetia</i>)	<i>Noetia</i> (<i>Noetia</i>)
<i>Mactra</i> (<i>Micromactra</i>)		<i>Mactra</i> (<i>Micromactra</i>)
<i>Tenuicorbula</i>	<i>Psammotreta</i>	<i>Tenuicorbula</i>
<i>Malea</i>		<i>Trochita</i>
<i>Parametaria</i>	<i>Cymia</i>	
<i>Strombina</i> (<i>Sincola</i>)	<i>Strombina</i> (<i>Sincola</i>)	<i>Parametaria</i>
<i>Hanetia</i>		<i>Strombina</i> (<i>Sincola</i>)
<i>Metula</i>		
<i>Cancellaria</i> (<i>Euclia</i>)		
<i>Cancellaria</i> (<i>Narona</i>)		

In such a list the oldest fauna is expected to yield the highest number, and the youngest fauna the lowest number of paciphile genera or subgenera. This, however, does not apply to the Courbaril fauna, which is attributed to the fact that the Courbaril fauna is the smallest and least complete one. The Courbaril fauna has yielded more species of pelecypods than gastropods, whereas the Melajo and Matura faunas both contain almost twice as many gastropods as pelecypods.

In the following lists the fossil species closely related to Recent Eastern Pacific species are tabulated for each fauna.

Melajo fauna

Fossil species	Recent species
<i>Calorhadia</i> (<i>Calorhadia</i>) <i>solivaga</i> , n.sp.	<i>C. costellata</i> (G. B. Sowerby I)
<i>Arcopsis</i> <i>adamsi</i> (Dall)	<i>A. solida</i> (G. B. Sowerby I)
<i>Dosinia</i> (<i>Dosinia</i>) <i>grandis</i> Nelson	<i>D. ponderosa</i> (Gray)
<i>Pitar</i> (<i>Lamelliconcha</i>) <i>circinatus</i> (Born)	<i>P. alternatus</i> (Broderip)
<i>Semele</i> <i>laevis costaricensis</i> Olsson	<i>S. laevis</i> (G. B. Sowerby I)
<i>Polinices</i> <i>stanislasmeunieri</i> Maury	<i>P. uber</i> (Valenciennes)

Courbaril fauna

Fossil species	Recent species
<i>Pitar (Lamelliconcha) circinatus</i> (Born)	<i>P. alternatus</i> (Broderip)
<i>Semele laevis costaricensis</i> Olsson	<i>S. laevis</i> (G. B. Sowerby I)
<i>Cymia brightoniana</i> Maury	<i>C. tecta</i> (Wood)

Matura fauna

Fossil species	Recent species
<i>Nucula (Lamellinucula) vieta</i> Guppy	<i>N. exigua</i> G. B. Sowerby I
<i>Arcopsis adamsi</i> (Dall)	<i>A. solida</i> (G. B. Sowerby I)
<i>Pitar (Lamelliconcha) circinatus</i> (Born)	<i>P. alternatus</i> (Broderip)
<i>Crucibulum (Crucibulum) piliferum</i> Guppy	<i>C. spinosum</i> (G. B. Sowerby II)
<i>Trivia (Pusula) radians orientalis</i> (Schilder)	<i>T. radians</i> (Lamarck)
<i>Parametaria rutschi</i> , n.sp.	<i>P. dupontiae</i> (Kiener)

As can be seen from the preceding lists the Matura fauna shows a relatively strong affinity to the Recent Eastern Pacific fauna. In addition there are two Matura species identical with Recent Eastern Pacific species, *i.e.* *Trochita radians* (Lamarck) and *Aesopus peculiaris* (Guppy) (see synonymy of the latter species).

It appears that the Matura fauna lived at a time when communication between Atlantic and Pacific was still possible or shortly thereafter. Authors differ as to the time of the final separation of the two oceans. According to Nygren (1950, p. 2005) the, "upper Miocene to Pliocene sediments of the Bolivar syncline are continental, excepting locally where the ocean entered through the destroyed western borderland or gulfs near the extremities of the geosyncline" and (p. 2006), "From upper Miocene to Recent the Bolivar portal was closed and should have been no obstacle for migration of many types of land faunas". Stirton (1950, p. 1541) stated that "in the late (Blancan) Pliocene a land route was established". According to Harrington (1962, p. 1806) and Whitmore and Stewart (1965, p. 185) the final separation of the two oceans occurred during the Pliocene.

It is concluded that the Matura fauna is of Pliocene, and probably of early Pliocene age, although a somewhat younger age cannot be excluded.

SUMMARY AS TO AGES

The following percentages are approximate only.

Percentage of still living species in:

Melajo fauna: 12

Courbaril fauna: 30

Matura fauna: 37

Affinities of the Melajo fauna to:

Courbaril fauna: 24%

Matura fauna: 18%

Recent fauna: 12%

Affinities of the Courbaril fauna to:

Melajo fauna: 43%

Matura fauna: 42%

Recent fauna: 30%

Affinities of the Matura fauna to:

Melajo fauna: 19%

Courbaril fauna: 25%

Recent fauna: 37%

The Melajo fauna is the oldest one of the three faunas studied. It is correlated, at least in part, with the late Miocene Savaneta Glauconitic Sandstone Member of the Springvale Formation. The Courbaril fauna is older than the Matura fauna and is considered to be of early Pliocene age. The Matura fauna indicates an early Pliocene age but is somewhat younger than the Courbaril fauna.

SYSTEMATIC PALEONTOLOGY
SCAPHOPODAFamily **DENTALIIDAE**Genus **DENTALIUM** Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 785.

Type species (by subsequent designation, Montfort, 1810, *Conchyliologie systématique*, vol. 2, p. 23), *Dentalium elephanti-num* Linné.

Subgenus **DENTALIUM** s.str.

Dentalium (Dentalium) divulgatum, n.sp.

Pl. 13, figs. 1, 2

Shell of medium size, moderately slender, increasing regularly in diameter. Maximum of curvature usually confined to posterior

part of shell. Apical cross section regularly hexagonal. Primaries sharply elevated but flattening in subsequent stages. Interspaces concave, crossed by faint growth lines. The two interspaces on the concave side of the shell usually somewhat wider. Six secondary longitudinal riblets are intercalated, those on the convex side mostly appearing earlier. Subsequently 12 tertiary threads are introduced. In late stages all the ribs are subequal in strength.

Holotype. — Natural History Museum Basel, No. G 12718.

Dimensions of holotype. — Length 33.5 mm; greatest diameter 3.8 mm.

Type locality. — Melajo River area: PJ 285.

D. divulgatum is common in the Melajo Clay and is represented by several hundred specimens. It is a variable species. The curvature is not constant, the secondaries are not always situated in the middle of the interspaces, and some of the tertiaries may be missing. On large specimens quaternary threads may be present. The number of ribs is usually larger on the convex side of the shell.

D. bocasense Olsson (1922, p. 166, pl. 15, figs. 2, 3) from the middle Miocene Gatun Formation of Panama has the same type of sculpture as *D. divulgatum*. But *D. bocasense* is a larger and heavier species with less curvature. *D. armillatum* Toulou (1911, p. 496, pl. 31, fig. 8) from the Gatun Formation of the Panama Canal Zone is more delicately sculptured, has numerous faint circular constrictions, and is less arched than *D. divulgatum*.

Occurrence. — Melajo River area: EL 1810, Hutch 47, Hutch 51, K 9797, K 9816, K 9817, K 9902, K 9903, KR 11862, RR 290, RR 293, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 1429, K 8399, PJ 212, USGS 10991, USGS 20432a, USGS 20433, USGS 20434, USGS 21778.

Dentalium (Dentalium) species

There are numerous fragments of a *Dentalium* representing many ontogenetic stages. There are six sharply elevated primary ribs with concave interspaces. The secondary sculpture consists of six riblets, and later 12 tertiary threads are intercalated. Most of the fragments are but slightly arched.

This form closely resembles *D. divulgatum*, n.sp. from the Melajo Clay, but the Matura specimens are not preserved well enough to be named.

Guppy (1867, p. 160; reprint, Harris, 1921, p. 39) listed the Recent *D. disparile* d'Orbigny and *D. antillarum* d'Orbigny from Matura. The latter species has nine primary ribs, a feature not represented in the material studied. *D. disparile* is a hexagonal species belonging to the subgenus *Antalis*, i.e. the longitudinal sculpture is lacking in old stages according to the definition.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Subgenus **GRAPTACME** Pilsbry and Sharp

Pilsbry and Sharp, 1897, Manual of Conchology, ser. 1, vol. 17, p. 85.

Type species (by subsequent designation, Woodring, 1925, Carnegie Inst. Washington, Pub. 366, p. 201), *Dentalium eboreum* Conrad.

Dentalium (Graptacme) cf. amaliense Henderson Pl. 13, fig. 3

Shell small, moderately slender, circular in cross section. Sculpture limited to posterior part of shell, consists of faint longitudinal threads which are separated by narrow grooves. Anterior part of shell smooth and considerably longer than sculptured portion. Apical slit long and narrow, placed laterally.

There are a few small fragments which may be referred to the Recent *D. amaliense* Henderson (1920, p. 71, pl. 11, figs. 4, 5) from St. Thomas, Virgin Islands. The holotype of that species is 16 mm long. The largest but incomplete specimen at hand measures 10.2 mm in length, and its greatest diameter is 1.8 mm, thus being somewhat stouter than the Recent species. One of the fragments shows the laterally placed apical slit which is about 2 mm long.

Woodring (1925, p. 202) described a fragment from Bowden, Jamaica, as *Dentalium (Graptacme)* species b which he thought to be similar to *D. amaliense*.

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Subgenus **LAEVIDENTALIUM** Cossmann

Cossmann, 1888, Catalogue illustré des coquilles fossiles de l'Eocène des environs de Paris, fasc 3, p. 11.

Type species (by original designation), *Dentalium incertum* Deshayes.

Dentalium (Laevidentalium ?) species

Three minute fragments from Matura, all of them about 3 mm

long, are at hand. They seem to belong to *Laevidentalium*. Their surface is smooth, the cross section circular. No apical notch is observable.

Occurrence. — K 10924, RR 230.

PELECYPODA

Family **NUCULIDAE**

Genus **NUCULA** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 87.

Type species (by monotypy), *Arca nucleus* Linné.

Subgenus **LAMELLINUCULA** Schenck

Schenck, 1944, Jour. Paleont., vol. 18, No. 1, p. 97.

Type species (by original designation), *Nucula tamatavica* Odhner.

Nucula (Lamellinucula) vieta Guppy Pl. 13, figs. 4-7

1867. *Nucula vieta* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 174; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 53.

1874. *Nucula vieta* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 443, pl. 18, figs. 8a, 8b.

1882. *Nucula vieta* Guppy, Guppy, Proc. Sci. Assoc. Trinidad, vol. 2, p. 171, pl. 7, fig. 11; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 92.

1925. *Nucula vieta* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 21.

Shell small, obliquely trigonal, almost as high as long, strongly inflated. Sculpture consists of numerous rounded, concentric ridges with somewhat narrower interspaces. Interspaces sculptured by fine radial lines mostly crossing the much heavier concentrics. On the anterior part of the shell the concentric ridges are more crowded, and two of them may fuse. Lunule slightly sunken, its border marked by an angulation of the concentrics. Its sculpture thus consists of fine ridges running perpendicular to the hinge margin. Border of escutcheon also marked by an abrupt change of sculpture. The escutcheon then appears knobby. The straight teeth number about six anteriorly, about 12 posteriorly. The two rows are separated by an oblique, narrow, forward looking resilial pit. Ventral margin finely crenulated interiorly.

Lectotype (herewith selected). — USNM 115562.

Dimensions of lectotype. — Length 3.1 mm; height 3.1 mm.

Type locality. — Matura, Trinidad.

The type lot of *N. vieta* consists of two small valves which had been glued to a card. The figured specimen from JS 67 is 4.9 mm long and 4.1 mm high. It is thus larger than the material studied by Guppy.

Rutsch (1942, p. 101) listed *Nucula* sp. ind. from Springvale Quarry. Examination of this material (Basel Natural History Museum, No. G 2318) suggests immature *N. vieta*. Larger specimens of later collections from Springvale Quarry confirm this determination.

N. gadsdenensis Mansfield (1937, p. 187, pl. 10, figs. 8, 10, 12) from the lower Miocene Tampa Limestone of Florida is even smaller than *N. vieta* but has the same general form and sculpture. It has no distinct escutcheon, whereas in *N. vieta* it is well developed. *N. cahuitensis* Olsson (1922, p. 171, pl. 18, figs. 21-24) from the middle Miocene Gatun Formation of Costa Rica is longer than *N. vieta* compared to the height and has a weaker sculpture.

N. venezuelana Weisbord (1964, p. 36, pl. 1, figs. 1-6) from the Pliocene Mare Formation of Venezuela is a similar species. Two small and apparently immature valves from the Cabo Blanco area, Venezuela, contained in the collections of the U. S. National Museum suggest *N. vieta*, although their concentrics are somewhat flatter.

N. vieta is practically indistinguishable from the Recent West Coast *N. exigua* G. B. Sowerby I (*in* Broderip and Sowerby, 1832-1833, p. 198, 1833; Olsson, 1961, p. 56, pl. 1, figs. 2, 2a, 2b, 10, 10a). *N. vieta* is known from a few shells only. More material might show that it should be treated as a synonym of *N. exigua*.

Occurrence. — JS 67, PJ 302.

Distribution. — Springvale Fm. (late Miocene). Matura shell bed.

***Nucula* (*Lamellinucula*) *baccata* Guppy** Pl. 13, figs. 8-12

- 1867. *Nucula baccata* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 174; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 53.
- 1874. *Nucula baccata* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 443, pl. 18, figs. 7a, 7b.
- 1882. *Nucula baccata* Guppy, Guppy, Proc. Sci. Assoc. Trinidad, vol. 2, p. 171, pl. 7, fig. 12; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 92.
- 1925. *Nucula baccata* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 20, pl. 12, fig. 5.

Shell small, strongly inequilateral, moderately inflated. Anterior extremity angulated. Posterior end produced and slightly angulated. Ventral margin evenly rounded. Anterior umbonal ridge accentuated; posterior umbonal ridge broadly rounded. Sculpture consists of crowded, rounded concentric ridges with narrower interspaces crossed by fine radial striae. Occasionally two concentrics fuse on the anterior portion of the shell. Lunule and escutcheon slightly sunken but not well defined. The concentrics continue without interruption but weaker over the anterior and posterior umbonal ridges and cover lunule and escutcheon. Anterior teeth almost straight numbering about seven. Posterior teeth angulated, about 17 in number. Resiliar pit narrow and oblique. Inner side of ventral margin finely crenulated.

Lectotype (herewith selected). — USNM 115561.

Dimensions of lectotype (left valve). — Length 7.0 mm, height 5.3 mm.

Type locality. — Matura, Trinidad.

The type lot of *N. baccata* consists of three valves which were glued to a card. The largest specimen from Matura at hand measures 7.8 mm in length and 5.8 mm in height. Immature specimens have an extremely weak sculpture. The heavier concentrics appear toward the ventral margin only. *N. baccata* occurs in the Melajo Clay and in the Courbaril beds as well, but no specimens from the type area of the Springvale Formation have been found.

N. tenuisculpta Gabb (1873b, p. 255; Pilsbry 1922, p. 401, pl. 38, fig. 6) from the Miocene of the Dominican Republic is a much smaller species and has no marginal angulation anteriorly. *N. orbicella* Olsson (1922, p. 171, pl. 28, figs. 19, 20) from the middle Miocene Gatun Formation of Costa Rica is a closely related species having the same outline, sculpture, and number of teeth. However, the sculpture of the escutcheon is different being pustule-like in *N. orbicella*.

Occurrence. — Melajo River area: K 9816, K 9817. Point Courbaril: USGS 20432, USGS 20434. Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm. Courbaril beds of upper Morne l'Enfer Fm., Matura shell bed.

Family **NUCULANIDAE**Genus **NUCULANA** Link

Link, 1807, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, p. 155.

Type species (by monotypy). *Arca rostrata* Chemnitz (= *Mya pernula* Müller).

Subgenus **SACCELLA** Woodring

Woodring, 1925, Carnegie Inst. Washington, Pub. 366, p. 15.

Type species (by original designation), *Arca fragilis* Chemnitz (= *Leda commutata* Philippi).

Nuculana (Saccella) ludificans, n. sp.

Pl. 13, figs. 13-16

Shell small. Beaks submedian. Anterior margin strongly rounded; posterior end pointed. Lunule indistinct. Rostral area sunken and concave, sculptured by straight, subparallel lines. Posterior umbonal ridge moderately prominent. Sculpture consists of fine concentric striae which are usually broader in young stages. Resiliifer inconspicuous. Hinge with 20 to 23 anterior and 15 to 19 posterior teeth.

Holotype (right valve).—Natural History Museum Basel, No. G 12677.

Dimensions of holotype.—Length 7.4 mm, height 3.7 mm.

Type locality.—Melajo River area: PJ 285.

N. ludificans is represented by more than a hundred specimens from the type locality of the Melajo Clay. It is a variable species. There are specimens which are less produced posteriorly. As a rule the concentric striae are narrow, but they may be broader as well.

The type lot of *Leda illecta* Guppy (1867, p. 174) from the middle Miocene Manzanilla Formation of Manzanilla Bay, Trinidad (USNM 115556), consists of six poorly preserved specimens. They all are fragmentary and attached to matrix thus not showing the interior. Guppy described them as smooth, but they are worn and show faint concentric sculpture on some specimens. Specimens of *N. ludificans* from Point Courbaril often show no concentric sculpture in the area of their greatest inflation which may be due to washing. They then closely resemble *N. illecta*. It is unsatisfactory, however, to identify *N. ludificans* as *N. illecta*.

N. leptalea (Gardner) [1926-1950 (1926), p. 16, pl. 3, figs.

7, 8] from the lower Miocene Chipola Formation of Florida is a smaller species with broader concentrics and a more prominent posterior umbonal ridge. *N. subibajana* Marks (1951, p. 49, pl. 1, figs. 1-3) from the lower Miocene Subibaja Formation of Ecuador is larger and considerably more convex. *N. extricata* (Pilsbry and Johnson) (1917, p. 185; Pilsbry 1922, pl. 38, figs. 1, 1a) from the Miocene of the Dominican Republic has the same general appearance but has different proportions. Its shell is higher compared to the length than in *N. ludificans*.

N. vulgaris (Brown and Pilsbry) (1913b, p. 499, fig. 3) from the Pleistocene near Mount Hope, Panama Canal Zone, has a coarser sculpture. Among the topotypes at hand there are specimens twice as large as *N. ludificans*. The Recent *N. eburnea* (G. B. Sowerby I) (*in* Broderip and Sowerby, 1832-1833, p. 198, 1833; Olsson, 1961, p. 62, pl. 2, figs. 4, 4a, pl. 3, fig. 10) from the west coast of Central America has virtually the same outline and type of sculpture as *N. ludificans*. *N. eburnea* differs by its larger size and the well-defined lunule.

Occurrence. — Melajo River area: EL 1810, Hutch 47, K 9817, K 9903, KR 11862, RR 290, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, K 8399, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434.

***Nuculana (Saccella) perlepida* (Guppy)**

Pl. 13, figs. 17-19

1867. *Leda perlepida* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 163, 173; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 42, 52.
 1874. *Leda perlepida* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442, pl. 18, figs. 9a, 9b.
 1925. *Leda perlepida* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 26, pl. 12, fig. 4.

Shell small, strongly inflated in young stages, less so later. Umbones situated centrally to slightly anteriorly. Sculpture consists of fine concentrics. Anterior margin evenly rounded; posterior extremity somewhat pointed. Postero-dorsal margin straight. Hinge with two rows of chevron-shaped teeth. Anterior row with more teeth than posterior one. Escutcheon moderately well defined, sculptured by straight lines which are subparallel to the postero-dorsal margin.

Lectotype (herewith selected). — USNM 115557.

Dimensions of lectotype (right valve). — Length 6.0 mm, height 3.8 mm.

Type locality. — Matura, Trinidad.

The type lot of *Leda perlepipda* consists of four specimens which had been glued to a card. The lectotype is the specimen figured by Guppy in 1874. The remaining three syntypes are immature. *N. perlepipda* does not have "occasionally deeper and wider concentric furrows" in addition to the finer concentrics. These "furrows" are a matter of coloration and do not form any undulating relief. The lectotype and the shell figured by Maury are the only specimens so far showing this coloration.

N. perlepipda is closely related to *N. subcerata* (Woodring) (1925, p. 17, pl. 1, figs. 6, 7) from Bowden, Jamaica. As stated by Woodring immature Bowden shells are practically indistinguishable from immature *N. perlepipda*. Adult *N. subcerata*, however, consistently has a more upturned posterior extremity than adult Matura valves.

N. ludificans, n. sp. differs from *N. perlepipda* in having a longer posterior extremity. *N. ludificans* typically has widely spaced concentric grooves in young stages, whereas in *N. perlepipda* they are closely set. Immature *N. ludificans* is never so stout and strongly inflated as immature *N. perlepipda*.

The type lot of the Recent *N. cerata* (Dall) (1881, p. 126) dredged at 100 fms. off Barbados consists of nine specimens. Their escutcheon is less well defined, the concentric grooves more widely spaced, and their anterior extremity more sharply curved.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

Genus **CALORHADIA** Stewart

Stewart, 1930, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 3, p. 51.

Type species (by original designation), *Leda pharcida* Dall.

As suggested by Stenzel, Krause, and Twining (1957, p. 47) the genus *Costelloleda* Hertlein and Strong [1940-1951 (1940), p. 398] (type species: *Nucula costellata* G. B. Sowerby I) is a subjective synonym of *Calorhadia*.

Subgenus **CALORHADIA** s. str.**Calorhadia (Calorhadia) solivaga**, n. sp.

Pl. 14, figs. 1, 2

Shell elongate, thin. Anterior margin angulated in upper half, evenly arched below. Exterior sculptured by widely spaced, elevated concentric lamellae. Interspaces with fine incrementals. Posterior slope with two squamose ridges. Their interspace crossed by fine incrementals and sometimes by a weak continuation of the lamellae of the main shell disc. Escutcheon lanceolate, smooth. Lunule sharply defined, but narrow. Anterior row of teeth shorter than posterior one; both with more than 30 teeth. Resilifer triangular.

Holotype. — Natural History Museum Basel, No. G 12678.

Dimensions of holotype (left valve). — Length 17 mm, height 6.5 mm.

Type locality. — Melajo River area: PJ 285.

This species is represented from the Melajo Clay by a few complete valves and a number of fragments. One of the paratypes is heavier and more inflated.

A number of *Calorhadias* have been described from the Eocene of the southern United States, but none of these species shows the distinctive external sculpture of distant concentrics like *C. solivaga*. *C. pharcida* (Dall) [1890-1903 (1898), p. 587, pl. 32, fig. 8], the type species of *Calorhadia*, has also much more crowded concentrics and seems to reach a larger size.

C. solivaga is most closely related to the Recent West Coast *C. costellata* (G. B. Sowerby I) [in Broderip and Sowerby 1832-1833, p. 198, 1833; Hertlein and Strong 1940-1951 (1940), p. 398, pl. 2, fig. 10] which ranges from Lower California to Panama (Olsson, 1961, p. 67). According to the many Recent specimens of *C. costellata* at hand *C. solivaga* has somewhat more distant concentric laminae. *C. solivaga* is more inflated, and its ventral margin is more strongly curved. *C. marella* (Hertlein, Hanna, and Strong) [in Hertlein and Strong, 1940-1951 (1940), p. 399, pl. 2, figs. 12, 13], also a Recent West Coast species, is easily distinguished from *C. solivaga* by its more closely set concentric lamellae.

The type lot of *C. cestrota* (Dall) (1890, p. 255, pl. 13, fig. 7) which has been collected near Colon (Caribbean side of Panama) from a muddy bottom at a depth of 25 fms. consists of eight shells including one double-valved specimen (USNM 94088). *C. cestrota*

is proportionately longer than *C. solivaga*, has closely spaced concentric lamellae, and its lower postero-dorsal ridge is only weakly indicated. *C. cestrota* may be the same as the Recent *C. egregia* (Guppy) (1882, p. 174, pl. 7, figs. 1, 2; reprint, Harris, 1921, p. 95, pl. 5, figs. 1, 2) from the Gulf of Paria, Trinidad. Guppy's original figures are so poor that the species cannot be recognized. In addition nothing is known about the types of *C. egregia*. However, *C. egregia* seems to have crowded concentric lamellae like *C. cestrota*.

Dall (in Guppy and Dall, 1896, p. 329) changed the name *Cercomya ledaeformis* Guppy (1866b, p. 581, pl. 26, fig. 1) into *Leda guppyi* which is unjustified. *Cercomya ledaeformis*, which has been collected from the middle Miocene Manzanilla Formation at Manzanilla Bay, Trinidad, is a *Calorhadia*. The type lot (USNM 115555) consists of a small and a larger specimen, both attached to matrix. They clearly show the two ridges on the posterior slope. Their concentric lamellae are distant on the umbonal area like in *C. solivaga* but become crowded toward the ventral margin. *C. ledaeformis* is proportionately more elongate than *C. solivaga*. *Leda dalliana* Olsson (1922, p. 175, pl. 28, fig. 17) from the middle Miocene Gatun Formation of Costa Rica seems to be a *Calorhadia*. According to the original description it must be closely related with *C. ledaeformis*.

Occurrence.—PJ 285, USGS 18399, USGS 21178.

Genus **ADRANA** H. and A. Adams

Adams, H. and A., 1858, The genera of Recent Mollusca; arranged according to their organization, vol. 2, p. 547.

Type species (by subsequent designation, Stoliczka, 1871, Palaeont. Indica, vol. 3, p. 320), *Nucula (Adrana) lanceolata* Lamarck.

Adrana perprotracta (Dall) ?

Pl. 14, figs. 3, 4

- 1912. *Yoldia perprotracta* Dall, Smithsonian Misc. Coll., vol. 59, No. 2, p. 1.
- 1913. *Yoldia perprotracta* Dall, Brown and Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., vol. 65, p. 496.
- 1925. *Yoldia perprotracta* Dall, Dall, U.S. Nat. Mus., Proc., vol. 66, art. 17, p. 32, pl. 18, fig. 3.
- 1953. *Yoldia (Adrana) perprotracta* Dall, Warmke and Abbott, Jour. Washington Acad. Sci., vol. 43, No. 8, p. 260, figs. 1, 2.

Shell thin, elongated, inequilateral. Beaks low. Anterior end

strongly arched, posterior end somewhat pointed. Ventral margin with a shallow sinus posterior to the beaks. Narrow lunule and escutcheon present. Sculpture consists of fine, concentric grooves with wider interspaces. Sculpture confined to the main shell disc, *i.e.*, to the area between anterior and posterior umbonal slopes. Anterior umbonal slope sometimes marked with a shallow radial depression. In front of the posterior umbonal slope the sculpture becomes eccentric, *i.e.*, the striae slowly approach the ventral margin. Rest of exterior surface covered by faint incrementals. Hinge almost straight. Adult specimens have about 38 anterior and 45 to 50 posterior teeth. Resilifer asymmetrically triangular.

Type lots.—USNM 214350 (one left valve and one double-valved specimen). USNM 605551 (17 shells including two double-valved specimens). Both lots were collected at the same locality.

Type locality.—Pleistocene near Mount Hope, Panama Canal Zone.

This species occurs abundantly in the Melajo Clay but is rare in the Courbaril beds.

A. kurzi (Mansfield) (1932a, p. 36, pl. 2, figs. 5, 8), from the late Miocene of Florida, is closely related to *A. perprotracta*? It differs in being proportionately higher. Its concentrics are more widely spaced and continuous over the antero-dorsal area which is not the case in *A. perprotracta*? On the other hand all the specimens in the type lot of *A. perprotracta* are proportionately longer, and their concentrics more crowded but not continuous over the antero-dorsal area. Thus the Trinidad fossils are closer to *A. perprotracta* than to *A. kurzi*.

The status of *A. agronomica* (Maury) (1925a, p. 405, pl. 12, fig. 12) is not clear, because the type (and only specimen) crumbled after being drawn. Marks (1951, p. 51, pl. 1, fig. 6) described *Nuculana (Adrana)* sp. from the lower Miocene Subibaja Formation of Ecuador. This form is insufficiently preserved to allow a comparison.

Adrana quitanensis (Olsson) (1922, p. 174, pl. 18, fig. 19) from the middle Miocene Gatun Formation of Costa Rica has similar dimensions and outline as the Trinidad fossils, but it is said to be "crossed on the lower half of the anterior two-thirds by even, oblique lines." This is not the case in the material under study.

Among the Recent West Coast Adranas *A. exoptata* Pilsbry and Lowe (1932, p. 107, pl. 17, figs. 8, 9) has some resemblance with *A. perprotracta* but is somewhat angulated antero-dorsally, and has less teeth.

Occurrence. — Melajo River area: KR 11862, Hutch 47, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 12013, PJ 212.

Family **ARCIDAE**

Genus **ARCA** Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 693.

Type species (defined by Opinion 189, Opinions and Declarations rendered by the Internat. Comm. Zool. Nomenclature, vol. 3, pp. 93-108, 1945), *Arca noae* Linné.

Subgenus **ARCA** s. str.

Arca (Arca) zebra zebra (Swainson)

Pl. 14, figs. 5, 6

- 1833. *Byssarca zebra* Swainson, *Zoological Illustrations*, ser. 2, vol. 3, pl. 118.
- 1844. Not *Arca zebra* Swainson, Reeve, *Conch. Icon.*, vol. 2, *Arca*, species 69, pl. 11, fig. 69.
- 1845. *Arca barbadensis* d'Orbigny in La Sagra, *Historia fisica, politica y natural de la isla de Cuba*, Spanish edition, tomo 5, *Moluscos*, p. 345.
- 1847. *Arca occidentalis* Philippi, *Abbildungen und Beschreibungen*, vol. 3, p. 29, *Arca*, pl. 4, figs. 4a, 4b, 4c.
- 1907. *Arca zebra* Swainson, Lamy, *Jour. de Conchyl.*, vol. 55 (ser. 4, vol. 9), p. 17.
- 1925. *Arca (Arca) occidentalis* Philippi, Woodring, *Carnegie Inst. Washington*, Pub. 366, p. 29, pl. 2, figs. 8, 9. For further citations see this publication.
- 1953. *Arca (Arca) occidentalis* Philippi, Olsson and Harbison, *Acad. Nat. Sci. Philadelphia, Mon.*, No. 8, p. 32.
- 1964. *Arca (Arca) zebra* (Swainson), Weisbord, *Bull. Amer. Paleont.*, vol. 45, No. 204, p. 50, pl. 2, figs. 16, 17. For additional citations see this publication.

More than 20 specimens from Matura representing many ontogenetic stages are at hand. The largest ones reach a length of more than 60 mm. The posterior emargination is not strongly pronounced usually but more so in young stages. The antero-dorsal angulation is variable like in Recent specimens.

Guppy listed the species from Matura as *A. noae*. *A. noae* is said to occur as far west as Bermuda (Lamy, 1907, p. 16). On the other hand *A. zebra* occurs as far east as Bermuda (Warmke and Abbott, 1961, p. 321, map 4). Comparison of many specimens of both species shows that there is no constant difference as both

species are variable. Many opinions have been expressed as to their relationship but without definite result. A solution seems possible only by comparing the anatomy of both forms.

Specimens from Bowden, Jamaica, are more elongate on an average than those from Matura. The depth of the posterior emargination seems more pronounced but is also variable according to Woodring (1925, pp. 29-30). Specimens from the Springvale Formation of Springvale Quarry have been described as *A. occidentalis miocica* by Vokes (1938, p. 8, fig. 1). Rutsch (1942, p. 109) questioned the value of this subspecies stating that large suites of both forms should be compared before taking a definite decision. However, the fossil form has finer ribs and more secondary riblets on the postero-ventral portion of the shell. The latter feature may be found on Recent specimens as well. But even then their primaries are considerably broader than on the fossil subspecies.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Miocene (Venezuela, Costa Rica, Jamaica, Dominican Republic, Florida). Pliocene (Florida). Pleistocene. Recent (West Indies to Cape Hatteras and Bermuda).

***Arca (Arca) imbricata imbricata* Bruguière** Pl. 14, figs. 7, 8

1792. *Arca imbricata* Bruguière, Encyclopédie Méthodique, vol. 1, p. 98 (refers to Lister, pl. 367, fig. 207).
 1819. *Arca umbonata* Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 6, p. 37 (refers to Lister, pl. 367, fig. 207).
 1845. *Arca americana* d'Orbigny in La Sagra, Historia fisica, politica y natural de la isla de Cuba, Spanish edition, tomo 5, Moluscos, p. 342. Atlas, pl. 28, figs. 1, 2, 1842.
 1907. *Arca imbricata* Bruguière, Lamy, Jour. de Conchyl., vol. 55 (ser. 4, vol. 9), p. 26.
 1964. *Arca (Arca) imbricata* Bruguière, Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 54, pl. 3, figs. 1-8. For additional citations see this publication.
 1965. *Arca (Arca) umbonata* Lamarck, Jung, Bull. Amer. Paleont., vol. 49, No. 223, p. 420, pl. 51, figs. 2, 4.

Several small, immature specimens from Matura are at hand. Like Recent shells of this species, the shape varies considerably. The byssal gape may or may not be strongly accentuated, and the posterior umbonal ridge is prominent, angulated, or rounded.

A. umbonata morantensis Woodring (1925, p. 30, pl. 2, figs. 10, 11) from Bowden, Jamaica, is a smaller species with coarser sculpture. Its affinities to *A. bowdeniana* Dall [1890-1903 (1898)],

p. 622, pl. 33, fig. 12] have been discussed by Woodring (1925, p. 31).

Occurrence. — Matura Bay: JS 67, RR 230, USGS 1820-l. Point Courbaril: USGS 20432a.

Distribution. — See Weisbord (1964, p. 58).

Genus **BARBATIA** Gray

Gray, 1842, Synopsis of the contents of the British Museum, ed. 44, p. 81.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 197), *Arca barbata* Linné.

Subgenus **BARBATIA** s. str.

Barbatia (Barbatia) candida (Helbling) Pl. 14, figs. 11, 12

1779. *Arca candida* Helbling, Abhandl. Privatges. Böhmen, vol. 4, p. 129, pl. 4, figs. 39, 40 and a.

1925. *Barbatia (Calloarca) candida* Gmelin, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 42, pl. 8, fig. 6.

1964. *Barbatia (Barbatia) candida* (Helbling), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 58, pl. 3, figs. 9-14. For additional citations see this publication.

This form is represented from Matura by three immature shells. Comparison with Recent specimens of the same size suggests that the fossil belongs to *B. candida*. *B. candida* is treated as a species of *Cucullaearca* by Reinhart (1935, p. 27).

Occurrence. — K 10924, RR 230.

Distribution. — See Weisbord (1964, p. 61).

Barbatia species

A single fragment from the base of the Melajo Clay measuring 31 mm in length indicates that the Melajo fauna includes also a large species of *Barbatia*. The fragment represents the antero-ventral part of a left valve. Its external sculpture is regular consisting of pairs of radial ribs. Two pairs of radials form a group of four, and these groups are separated from each other by wider interspaces. All the radials are beaded anteriorly.

Occurrence. — USGS 18411.

Subgenus **Acar** Gray

Gray, 1857, Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 369.

Type species (by subsequent designation, Woodring, 1925, Carnegie Inst. Washington, Pub. 366, p. 36), *Arca gradata* Broderip and G. B. Sowerby I.

Stoliczka (1871, p. 340) did not designate a type species of *Acar* as indicated by some authors.

Barbatia (Acar) domingensis (Lamarck)

Pl. 15, figs. 1, 2

1819. *Arca domingensis* Lamarck, Histoire naturelle des animaux sans vertèbres, vol 6, p. 40.
 1907. *Arca (Acar) plicata* Chemnitz, Lamy, Jour. de Conchyl., vol. 55, (ser. 4, vol. 9), p. 80.
 1925. *Barbatia (Acar) reticulata* Gmelin, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 43, pl. 8, figs. 18, 21.
 1964. *Barbatia (Acar) domingensis* (Lamarck), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 61, pl. 4, figs. 1-9. For further citations see this publication.

Shell of small to medium size. Anterior margin evenly rounded, with fine crenulations interiorly. Ventral margin oblique to hinge, smooth. Posterior margin pointed with interior crenulations. Umbos low, broad, strongly prosogyrate. Sculpture reticulate, considerably coarser on posterior portion of shell. Concentric ridges stronger and less numerous than the radial ribs. Radials thickened on concentric ridges but narrow in the interspaces of the concentrics. Posterior umbonal ridge strongly angulated. Cardinal area narrow. Behind the umbos a few ligamental grooves. Muscle scars prominent and elevated.

This is the species listed as *A. squamosa* by Guppy (1867, p. 164; 1874, p. 443). It is common at Matura being represented by more than 30 specimens.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Miocene to Recent (see Weisbord, 1964, p. 64).

Subgenus **FUGLERIA** Reinhart

Reinhart, 1937, Jour. Paleont., vol. 11, No. 3, p. 184.

Type species (by original designation), *Barbatia (Fugleria) pseudoillota* Reinhart.

Barbatia (Fugleria ?) millifila latrinidadis Maury

Pl. 14, figs. 9, 10

1925. *Barbatia (Acar) milifilia* [sic] *latrinidadis* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 44, pl. 8, fig. 3.

Shell small, inequilateral. Umbos low, broad, strongly prosogyrate, somewhat angulated posteriorly. Anterior margin evenly rounded. Postero-ventral margin moderately produced. Sculpture consists of about 30 primary ribs. The anterior ones and those

around the posterior umbonal ridge are broader and strongly beaded. The central ribs are narrow and only slightly beaded. Those on the posterior slope are narrower again but strongly beaded. Secondary ribs first appear anteriorly, then centrally. No secondaries around posterior umbonal ridge and on posterior slope. Cardinal area narrow, wider in front. Hinge with about 24 teeth, those of the posterior half shorter than the anterior ones. Inner margin smooth.

Holotype (left valve). — Paleont. Research Inst., Ithaca, N. Y., No. 817.

Dimensions of holotype. — Length 17.5 mm, height 13.0 mm, convexity 5.5 mm.

Type locality. — Matura, Trinidad.

Maury described this form as a subspecies of the Pliocene *B. millifila* (Dall) [1890-1903 (1903), p. 1629, pl. 56, figs. 21, 24] from Shell Creek, Florida. Reinhart (1937, p. 184) doubtfully included *B. millifila* in his subgenus *Fugleria*. Originally *Fugleria* was meant to include forms with reduced or absent posterior teeth as shown by its type species, *B. pseudoillota* Reinhart, from the Pliocene of California. But Olsson (1961, p. 83) enlarged its definition: “. . . the posterior set of teeth well developed or sub-obsolete.” According to this statement *B. millifila*, which has well-developed posterior teeth, and the subspecies *latrinidadis*, which has only slightly reduced posterior teeth, belong to *Fugleria*.

The type lot of *B. millifila* (USNM 163473) consists of two specimens which are less elongate than the Trinidad fossils. The collections of the U. S. National Museum contain specimens from the late Miocene of Acline, Florida, which might be identified as *B. millifila*, although they have a more elongate outline like the Trinidad subspecies. On the other hand they may have divided primary radials postero-ventrally like specimens from Shell Creek, a feature never observed on Matura shells.

The collections of the U. S. National Museum contain a single specimen from the Pliocene of Moin Hill near Puerto Limon, Costa Rica (USGS locality 5884 b), which probably represents *B. millifila latrinidadis*.

A lectotype of the Recent Caribbean *B. tenera* (C. B. Adams) (1845, p. 9) has been selected and figured by Clench and Turner

(1950, p. 348, pl. 43, figs. 1, 2). This species has clearly reduced posterior teeth, thus being a real *Fugleria*. The Recent West Coast *B. illota* (G. B. Sowerby I) (1833-1834, p. 18, 1833; Maury, 1922, pl. 2, figs. 8, 14; Olsson, 1961, pl. 6, figs. 1, 1a, 1b) has tertiary riblets which do not seem to occur in *B. tenera*.

Occurrence. — RR 230, PJ 302, USGS 18204.

Distribution. — Matura, Trinidad. Pliocene of Costa Rica (?).

Genus **ARCOPSIS** von Koenen

Von Koenen, 1885, Abh. Königl. Ges. Wiss. Göttingen, Phys. Classe, vol. 32, pt. 2, p. 86.

Type species (by subsequent designation, Reinhart, 1935, Bull. Mus. royal Hist. nat. Belgique, vol. 11, No. 13, p. 30), *Arca limopsis* von Koenen.

Arcopsis adamsi (Dall)

Pl. 15, figs. 3-6

- 1845. *Arca caelata* Conrad, Fossils of the Medial Tertiary Formations of the United States, p. 61, pl. 32, fig. 2. Not of Reeve, 1844.
- 1867. *Arca adamsi* Shuttleworth, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 164; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 43.
- 1874. *Arca adamsi* Shuttleworth, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 443.
- 1925. *Barbatia (Fossularca) adamsi* (Shuttleworth), Smith, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 45, pl. 8, figs. 1, 8.
- 1925. *Fossularca (Fossularca) adamsi sawkinsi* Woodring, Carnegie Inst. Washington, Pub. 366, p. 51, pl. 5, figs. 16, 17.
- 1964. *Arcopsis adamsi* "Shuttleworth" (E. A. Smith), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 65, pl. 4, figs. 14-17, pl. 5, figs. 1-6. For further citations see this publication.
- 1965. *Arcopsis (Arcopsis) adamsi* (Dall), Bird, Palaeont. Amer., vol. 5, No. 34, p. 25, pl. 1, figs. 7, 8.

Shell small. Shape strongly variable, from moderately elongate-subrectangular to stout-subtrapezoidal. Umbos low, broad, subcentral. Posterior umbonal ridge accentuated. Sculpture consists of numerous radials which are crossed by fine concentrics forming more or less strong beads at the intersections. This reticulate sculpture is always developed in young stages, but on adult specimens the concentrics may disappear. Secondary radials are present on the central portion of the shell which is shallowly depressed in older individuals. Posterior teeth more numerous than anterior ones. Cardinal area narrow. Ligamental area triangular, subumbonal. Muscle scars elevated.

As mentioned above this species has considerable variability.

Rutsch (private report) listed *A. solida* (G. B. Sowerby I) (1833-1834, p. 18, 1833; Olsson, 1961, p. 85, pl. 6, figs. 3, 3a, 3b), the Recent West Coast analogue of *A. adamsi*, from Matura. Rutsch had four adult valves at hand which indeed look more like *A. solida* than *A. adamsi*. They are stout, strongly inflated, and have lost most of the concentric sculpture like the specimens figured by Maury (1925, pl. 8, figs. 1, 8). However, more recent collections from Matura yielded more elongate specimens with reticulate sculpture some of them being immature. Only a comparison of large series of both species could show whether there are steady transitions or not. Almost the same circumstances are found in a large lot of *A. adamsi* from the Caloosahatchee Pliocene of Shell Creek, Florida. In Recent lots the variability is less marked; stout and strongly inflated individuals retain the concentric sculpture even in adult stages.

Dall (1886, p. 243; 1902, p. 508, pl. 31, fig. 1) proposed the subspecific name *conradiana* for small, squarish, Recent shells. A sample from the Gulf of Mexico at hand, dredged at 54 fathoms east of the Mississippi Delta, contains specimens referable to this subspecies. They differ from *A. adamsi* by a more accentuated posterodorsal angulation and a much broader cardinal area.

The specimens described by Rutsch (1942, p. 111, pl. 3, figs. 3, 4) from Springvale Quarry are immature and identical with shells of the same size from Matura. Imperfectly preserved young specimens occur in the Melajo Clay as well.

Occurrence. — Melajo River area: K 9817, PJ 285. Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Miocene to Recent (see Weisbord, 1964, p. 68).

Genus **ANADARA** Gray

Gray, 1847, Zool Soc. London, Proc., pt. 15, p. 198.

Type species (by original designation), *Arca antiquata* Linné.

Subgenus **ANADARA** s. str.

Anadara (Anadara) aff. inaequilateralis (Guppy)

Shell elongate, ventral margin almost parallel to hinge. Umbos low and broad, mesially sulcate, situated well anteriorly. Ribs 27 to 29, somewhat broader on left valve with correspondingly wider interspaces on right valve. Ribs and interspaces crossed by fine

concentric threads. The ribs around the posterior umbonal ridge seem to be divided in adult specimens. Cardinal area narrow. Inner margin crenulated.

A number of mostly immature shells from the Courbaril beds and the Melajo Clay have almost the same outline and degree of inflation as *A. inaequilateralis* (Guppy) (1866a, p. 293, pl. 18, fig. 2) from Bowden, Jamaica. Comparison with topotypes shows that the Bowden shells differ in being proportionately higher posteriorly and in having divided ribs anteriorly and posteriorly. Only a few specimens from the Courbaril beds and the Melajo Clay have an indication of divided ribs.

Occurrence. — Melajo River area: Hutch 51, K 9817, KR 11862, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 1429, USGS 10991, USGS 20432, USGS 20434.

Subgenus **CUNEARCA** Dall

Dall, 1898, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 4, p. 618.

Type species (by monotypy), *Arca incongrua* Say.

Anadara (Cunearca) brasiliana (Lamarck)

- 1819. *Arca brasiliana* Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 6, p. 44.
- 1822. *Arca incongrua* Say, Acad. Nat. Sci. Philadelphia, Jour., ser. 1, vol. 2, pt. 2, p. 268.
- 1925. *Scapharca (Cunearca) incongrua* Say, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 66, pl. 7, fig. 6.
- 1925. *Scapharca (Cunearca) brasiliana* Lamarck, Maury, *ibidem*, p. 66, pl. 4, figs. 1, 4, 5.
- 1925. *Scapharca (Cunearca) sanctiandreae* Maury, *ibidem*, p. 67, pl. 5, fig. 6.
- 1964. *Anadara (Cunearca) brasiliana* (Lamarck), Weisbord; Bull. Amer. Paleont., vol. 45, No. 204, p. 79, pl. 6, figs. 13-16. For additional citations see this publication.

Shell large, rhomboidal. Umbos high, subcentral. slightly prosogyrate. Sculpture consists of 26 to 30 broad radials carrying coarse transverse beads anteriorly. Sculpture on left valve stronger. Distal teeth of hinge converging ventrally. Cardinal area broad, triangular, transversely striated, bordered by a prominent groove. Inner margin strongly fluted.

There are two imperfectly preserved valves from Matura and a large right valve from Point Courbaril (length 47 mm, height 44 mm). The larger Matura specimen is 43 mm long.

Another valve from Matura resembles what Maury described as *A. sanctiandreae*, the type locality of which is Matura. This valve

has also a shallow radial depression in front of the posterior umbonal ridge, but its beading is restricted to the anterior part of the shell, although it is a left valve. Recent specimens of *A. brasiliiana* from Galveston, Texas, have also a shallow radial depression in front of the posterior umbonal ridge, but their ribs are more strongly beaded. There are also some Recent left valves from Trinidad which have this depression, and their beads on the ribs are restricted to the anterior part of the shell. Thus it seems that *A. sanctiandreae* is immature *A. brasiliiana*.

A. willardausteni (Maury) (1917, p. 179, pl. 29, figs. 6, 7) from the Cercado Formation of the Dominican Republic is a smaller species, more inequilateral, and has more numerous but less strongly beaded ribs. According to Olsson (1961, p. 95) the Recent West Coast *A. bifrons* (Carpenter) is generally smaller, more rhombic in shape, and the sculpture is smoother. *A. esmeralda* (Pilsbry and Olsson) (1941, p. 53, pl. 13, figs. 4, 5) from the Pliocene of western Ecuador is a similar species but has chevron-shaped grooves on the cardinal area according to the original description.

Occurrence. — Point Courbaril: USGS 20433. Matura Bay: JS 67, RR 230.

Distribution. — Upper Miocene to Recent (see Weisbord, 1964, p. 82).

Anadara (Cunearca) aff. *filicata* (Guppy)

Pl. 15, fig. 7

Shell of small to medium size, inequilateral, inequivalve. Umbos high and full. Anterior margin regularly rounded, ventral margin somewhat straightened, postero-ventrally produced. Sculpture consists of about 27 ribs which are transversely beaded on left but less so on right valve. Posterior umbonal ridge moderately accentuated to rounded.

This form belongs to a heterogeneous group which includes *A. filicata* (Guppy), *A. thalia* (Olsson), *A. pittieri* (Dall), *A. lloydi* (Olsson), *A. hindsii* (Olsson), the Recent *A. chemnitzii* (Philippi), and others. The material at hand shows a considerable variability mainly concerning the prominence of the posterior umbonal ridge which influences the general shape of the shell.

A. filicata (Guppy) (1866b, p. 583, pl. 26, fig. 5) from the Manzanilla Formation of Trinidad generally has a rounded pos-

terior umbonal ridge. Maury (1925, p. 68, pl. 8, fig. 5) did not figure a typical specimen. The ribs of the right valve of *A. filicata* carry inconspicuous beads, whereas in the present form they are smooth in front of the posterior umbonal ridge. In *A. pittieri* (Dall) (1912, p. 9) from the Gatun Formation of the Panama Canal Zone and Costa Rica the posterior umbonal ridge is accentuated usually. The type of *A. pittieri* has been figured by Dall (1925, pl. 17, fig 7). The present material does not reach the size of *A. pittieri*. *A. alcima* (Dall) [1890-1903 (1898), p. 635, pl. 31, figs. 5, 7] from the Caloosahatchee Pliocene of Florida is a larger species. A single specimen from the Melajo River area reaches a similar size but has a higher cardinal area.

A. chemnitzoides (Maury) (1912, p. 44, pl. 7, figs. 13-15, pl. 8, fig. 1) should be considered as a *nomen dubium*. It is based on incomplete moulds. A lectotype of *A. chemnitzoides* is herewith selected and figured (Pl. 15, figs. 8, 9). Its type locality is at milepost 49 $\frac{1}{2}$ (new mileposts!) of the Southern Main Road of Trinidad, just south of the Pitch Lake (= USGS 21782). This locality falls within the Upper Morne l'Enfer Formation, and has approximately the same age as the Courbaril beds. It is not possible to differentiate topotypes of *A. chemnitzoides* (moulds) at hand from moulds clearly belonging to *A. filicata*. The Recent *A. chemnitzii* (Philippi) (1851, p. 50) mainly differs by its larger size.

Occurrence. — Melajo River area: Hutch 51, K 9797, K 9813, KR 11862, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 1429, K 8399, K 12255, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 20433, USGS 20434, USGS 21778.

Subgenus **SCAPHARCA** Gray

Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 198.

Type species (by original designation), *Arca inaequalis* Bruguière.

Anadara (Scapharca ?) sanctidavidis (Maury) Pl. 15, figs. 10, 11

1925. *Scapharca* (*Scapharca*) *transversa sanctidavidis* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 64, pl. 6, fig. 3.

Shell of medium size, inequilateral, moderately inflated. An-

terior and posterior margins evenly rounded. Ventral margin oblique to hinge line. Sculpture consists of 30 to 35 radials which may be beaded anteriorly. Umbos low. Posterior umbonal ridge inconspicuous. Teeth vertical centrally but converge ventrally toward the ends. Cardinal area narrow. Inner margin fluted.

Holotype. — Paleont. Research Inst., Ithaca, N.Y., No. 799.

Type locality. — Matura, Trinidad.

There are only four right valves at hand. The beading of the anterior ribs is inconspicuous due to rolling. The subgeneric assignment is doubtful as there are no left valves to show whether this species is inequivalve with discrepant sculpture.

Maury described this form as a subspecies of *A. transversa* (Say) (1822, p. 269). Bird (1965, p. 30, pl. 2, figs. 4, 5, 6, 7, 9; pl. 6, fig. 5) redescribed *A. transversa* as an *Anadara s. str.* taking several of Conrad's species in its synonymy. It ranges from Miocene to Recent. As stated by Maury the Matura species differs mainly from *A. transversa* by its oblique ventral margin. According to Warmke and Abbott (1961, p. 159) *A. transversa* occurs not only south of Cape Cod to Florida and Texas, but in the West Indies as well.

Occurrence. — RR 230.

Distribution. — Known from type locality only.

***Anadara (Scapharca) placata*, n. sp.**

Pl. 16, figs. 1-3

Shell small, strongly inequilateral, somewhat inequivalve. Umbos moderately high, strongly sulcated mesially. Anterior margin evenly rounded. Ventral margin extends upwards from lowest point into prominent postero-ventral production. Postero-dorsal margin straight. Posterior umbonal ridge prominent in young, rounded in older stages. Sculpture consists of 26 to 28 ribs which are beaded anteriorly but less so on right valve. Posterior ribs smooth. Interspaces crossed by fine threads. Cardinal area moderately broad, bordered by an incised line. In adult specimens hinge with about 17 anterior and 21 posterior teeth. Inner margin strongly fluted.

Holotype. — Natural History Museum Basel, No. G 12884.

Dimensions of holotype (right valve). — Length 19.6 mm, height 14.4 mm, convexity 6.4 mm.

Type locality. — Melajo River area: KR 11862.

A. placata is abundant in the type region. The sculptural discrepancy in the two valves is not pronounced. The postero-ventral production is less accentuated in immature specimens.

The Recent West Coast *A. adamsi* Olsson (1961, p. 90, pl. 6, figs. 7, 7a, 7b) has the same general appearance as *A. placata* but seems to be an *Anadara s. str.*. Moreover *A. adamsi* has a radial depression in front of the posterior umbonal ridge.

Occurrence. — Melajo River area: EL 1810, Hutch, 47, Hutch 51, KR 11862, K 9902, K 9903, K 9797, K 9817, RR 290, PJ 285, USGS 18399, USGS 18634, USGS 21178.

Genus **LUNARCA** Gray

Gray, 1857, Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 372.

Type species (by monotypy), *Arca costata* Gray = *A. pexata* Say = *A. campechiensis* Gmelin = *A. ovalis* Bruguière.

As pointed out by Reinhart (1943, p. 75), Bird (1965, p. 32), and others the name *Argina* Gray is preoccupied by *Argina* Huebner (Lepidoptera). According to Sherborn and Prout (1912, p. 179) Huebner's work "Verzeichniss bekannter Schmetterlinge" was issued in several parts, and the page (p. 167) on which *Argina* is described, probably appeared in 1822. As the type species of *Lunarca*, *A. costata*, is believed to be an abnormal form of the type species of *Argina* Gray, *A. pexata* Say (1822, p. 268) (type species by subsequent designation, Stoliczka, 1871, Palaeont. Indica, vol. 3, p. 339), the latter genus is a synonym of *Lunarca*.

McLean (1951, p. 17) proposed *Arginarca* (type species by original designation, *A. campechiensis* Gmelin = *A. pexata* Say) as a substitute name for *Argina* Gray. Because *A. campechiensis* and *A. pexata* are synonyms, *Arginarca* is a synonym of *Lunarca* as well. Moreover *A. campechiensis* Gmelin (Systema Naturae, vol. 1, pt. 6, p. 3312, 1791) is a synonym of *A. ovalis* Bruguière (Encycl. Méth., vol. 1, pt. 1, p. 110, 1789).

Lunarca billingsiana (Maury)

Pl. 16, figs. 4-7; Pl. 17, figs. 1-4

1867. *Arca pexata* Say, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 164; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 43 (cited from Matura).

1912. *Arca (Argina) billingsiana* Maury, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 15, p. 45, pl. 8, figs. 2, 3.

1912. *Arca (Argina) brightonensis* Maury, *ibidem*, p. 46, pl. 8, figs. 4, 5, 6.

1925. *Scapharca (Argina) brightonensis* Maury, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 76, pl. 7, fig. 7.

1925. *Scapharca (Argina) billingsiana* Maury, Maury, *ibidem*, p. 76, pl. 6, fig. 2.
1925. *Argina billingsiana maturensis* Maury, *ibidem*, p. 78, pl. 5, fig. 3, pl. 6, figs. 9, 11.

Shell of medium size, inequilateral, elongate. Umbos strongly prosogyrate, broad, low. Anterior and posterior margins regularly rounded, ventral margin oblique to hinge. Ribs 30 to 35 with fine medial grooves on central part of left valve. Ribs of right valve usually somewhat narrower than those of left valve. Interspaces narrower than ribs, and crossed by fine growth lines. Cardinal area narrow, situated behind the beaks. Anterior set of teeth consists of about seven irregular and partly broken teeth; posterior set with about 35 teeth. Inner margin strongly fluted.

Lectotype of A. billingsiana (herewith selected). — Cornell University, Paleont. Museum, No. 38297: left valve.

Dimensions of lectotype of A. billingsiana. — Length 31.3 mm, height 22.7 mm.

Type locality of A. billingsiana. — Along shore, 700 feet east of Brighton pier, SW Trinidad.

Lectotype of A. brightonensis (herewith selected). — Cornell University, Paleont. Museum, No. 38295: left valve.

Dimensions of lectotype of A. brightonensis. — Length 24.7 mm, height 19.5 mm.

Type locality of A. brightonensis. — Along shore, 700 feet east of Brighton pier, SW Trinidad.

Lectotype of A. billingsiana maturensis (herewith selected). — Paleont. Research Inst., Ithaca, N.Y., No. 804: right valve. Specimen figured by Maury (1925, pl. 6, fig. 9).

Dimensions of lectotype of A. billingsiana maturensis. — Length 31.3 mm, height 22.2 mm, convexity 9.3 mm.

Type locality of A. billingsiana maturensis. — Matura, Trinidad.

Maury (1912) described a number of species of *Lunarca* from Trinidad. The two Recent species, *L. schultzana* and *L. pariaensis* are the same as *L. ovalis* (Bruguère). The three fossil forms listed in the above synonymy represent one species. The differences indicated by Maury fall within the variability. The pronounced postero-dorsal angulation is not typical for specimens from Matura but for immature shells in general, although not throughout. Speci-

mens from Matura are not less inflated, their umbos are not lower, and the number of ribs is about the same as in *L. billingsiana*.

L. billingsiana is well separated from the Recent *L. ovalis* (Bruguère) by its more elongate form. Recent specimens from Puerto Mexico at hand are almost as high as long, and they rarely reach the number of 30 ribs. Recent shells from Trinidad are somewhat more elongate than those from Puerto Mexico, but clearly less than *A. billingsiana*. According to McLean (1951, pp. 17-18) the Recent species has a considerable variability as to shape and number of ribs, but no geographical correlation seems possible.

Occurrence. — Point Courbaril: K 1429, K 8399, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778. Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Genus **NOETIA** Gray

Gray, 1857, Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 371.

Type species (by monotypy), *Noetia triangularis* Gray (= *Arca reversa* G. B. Sowerby I).

Subgenus **NOETIA** s. str.

Noetia (Noetia) sheldoniana (Maury) Pl. 17, figs. 5-8; Pl. 18, figs. 1, 2

1912. *Arca (Noetia) sheldoniana* Maury, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 15, p. 43, pl. 8, figs. 10, 11.

1925. *Noetia sheldoniana* Maury, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 39, pl. 8, fig. 11.

1938. *Noetia sheldoniana* Maury, MacNeil, U. S. Geol. Sur., Prof. Paper 189-A, p. 37, pl. 6, figs. 18, 19.

Holotype. — Cornell University, Paleont. Museum, Ithaca, N.Y., No. 38296.

Type locality. — Along shore, 1000 feet west of Brighton pier, Trinidad.

N. sheldoniana was described and compared in detail by MacNeil (1938). Its type locality, lying northwest of the Pitch Lake, has disappeared but was part of the Courbaril beds of the Upper Morne l'Enfer Formation. Specimens from the type locality of the Courbaril beds and from the Melajo River area exactly fit the descriptions and the several figures of the holotype of *N. sheldoniana*.

The material from Matura is assigned to *N. sheldoniana* as well, although the specimens are not typical. Matura shells reach a much larger size, the posterior margin is less steep and more produced postero-ventrally, and there are only 34 to 36 ribs instead of 38. Immature specimens from Matura, however, have the same shape as typical *N. sheldoniana*. The larger size, the more produced postero-ventral extremity, and the lower number of ribs seem to represent a development toward the Recent Pacific Coast *N. reversa* (G. B. Sowerby I) (1833-1834, p. 20, 1833; Olsson, 1961, p. 101, pl. 10, figs. 1, 1a, 1b). But *N. reversa* has a straighter posterior margin, and the beaks are situated more posteriorly.

Occurrence. — Melajo River area: Hutch 51, K 9813, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, USGS 10991, USGS 20433, USGS 20434. Matura Bay: JS 67, RR 230, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Subgenus **EONTIA** MacNeil

MacNeil, 1938, U.S. Geol. Sur., Prof. Paper 189-A, p. 11.

Type species (by original designation), *Arca ponderosa* Say.

Noetia (Eontia) centrota (Guppy)

Pl. 18, figs. 3-6

1867. *Arca centrota* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 175; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 54.
 1873. Not *Arca centrota* Guppy, Guppy, Proc. Sci. Assoc. Trinidad, vol. 2, p. 92, pl. 3, figs. 4a, 4b; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 75, pl. 1, figs. 4a, 4b.
 1874. *Arca centrota* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 443 (part), pl. 18, fig. 23
 1875. Not *Arca centrota* Guppy, Guppy, Ann. Mag. Nat. Hist., ser. 4, vol. 15, p. 51, pl. 7, figs. 4a, 4b.
 1925. *Noetia centrota* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 38, pl. 8, figs. 10, 12.
 1938. *Eontia centrota* (Guppy), MacNeil, U.S. Geol. Sur., Prof. Paper 189-A, p. 12, pl. 1, figs. 11, 12. Lectotype figured.
 1942. *Eontia centrota* (Guppy), Rutsch. Verh. Naturf. Ges. Basel, vol. 54, p. 110.

Lectotype. — USNM 496508.

Type locality. — Matura, Trinidad.

This species is abundant at its type locality. Its outline shows a considerable variability concerning the steepness of the posterior margin. Some specimens are unusually strongly produced postero-ventrally (see Pl. 18, figs. 3, 4).

N. centrota tends to be larger than the Recent Caribbean *N. bisulcata* (Lamarck), and usually it has more ribs. In *N. bisulcata* the ventral margin is less oblique to the hinge, although there are exceptions. Further comparisons have been given by MacNeil (1938, pp. 12, 13).

Miocene representatives of *N. centrota* are rare as stated by several authors. They differ from Matura specimens only by their smaller size but are indistinguishable from immature *N. centrota*. Except at Matura Bay *N. centrota* occurs in Trinidad in the Gransauil Clay Member, the Savaneta Glauconitic Sandstone Member, the Melajo Clay Member (all Springvale Formation), and in the Courbaril beds of the Upper Morne l'Enfer Formation. A form closely related to *N. centrota* has been recorded from the upper middle Miocene of Venezuela (Jung, 1965, p. 436, pl. 53, figs. 8, 9).

Occurrence.—Melajo River area: KR 11862, PJ 285, USGS 18399. Point Courbaril: K 1429, K 8399, PJ 212, USGS 20432, USGS 20433, USGS 20434, USGS 21778. Matura Bay: K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution.—Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Family GLYCYMERIDAE

Genus GLYCYMERIS da Costa

Da Costa, 1778, *Historia Naturalis Testaceorum Britanniae*, or the British Conchology, p. 168.

Type species (by tautonymy), *Glycymeris orbicularis* da Costa (= *Arca glycymeris* Linné).

Subgenus GLYCYMERIS s. str.

Glycymeris (Glycymeris) cf. undata (Linné)

Pl. 18, figs. 7, 8

A number of small and probably immature specimens from Matura have somewhat opisthogyrate beaks, but the ligament is amphidetic. Valves slightly inequilateral. Sculpture consists of numerous radials which are low and broad ventrally. With increasing age they carry superimposed radial threads. Fine concentric threads are developed.

The material is too poor, and the specimens are too much rolled to make a definite determination possible.

Occurrence.—JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Genus **TUCETONA** Iredale

Iredale, 1931, Records of the Australian Museum, vol. 18, No. 4, p. 202.

Type species (by original designation), *Pectunculus flabellatus* Tennison-Woods.

Tucetona cf. **pectinata** (Gmelin)

There is a single, small fragment from Matura. It shows an erect, centrally placed umbo and an amphidetic ligament. The sculpture consists of 27 single, rounded ribs which are well separated by their interspaces. Ventral margin not preserved.

Occurrence. — PJ 302.

Family **MYTILIDAE**Genus **BRACHYDONTES** Swainson

Swainson, 1840, Treatise on Malacology, p. 384.

Type species (by monotypy), *Modiola sulcata* Lamarck.

Subgenus **BRACHYDONTES** s. str.**Brachydontes (Brachydontes)** species

Pl. 18, figs. 9, 10

The material from Matura is too poor and rolled to point out affinities to known species. It consists of a few fragments mostly having the umbonal region and the hinge preserved, but none is complete to show the entire outline.

The material from Point Courbaril is also poor, but more details are preserved. The beaks are subterminal, the hinge consists of three teeth, and the antero-dorsal margin is strongly crenulated. The antero-ventral margin may be somewhat concave. The sculpture consists of prominent radial ribs. Their number is increased by dichotomy and intercalation or intercalation. Concentric sculpture of fine threads, which cross the radials, give them a beaded appearance.

The specimens from Matura and Point Courbaril may represent the same species. They all have a strongly accentuated umbonal ridge and a steep ventral margin.

The umbonal ridge is less pronounced in *B. guppyi* (Dall) [1890-1903 (1898), p. 794, pl. 35, fig. 16; Woodring, 1925, p. 85, pl. 10, figs. 10-12] from Bowden, Jamaica, and in *B. venustus* Olsson and Harbison (1953, p. 62, pl. 8, fig. 12) from the Pliocene of

St. Petersburg, Florida. *B. guppyi* has a more produced postero-dorsal extremity.

The material studied, although smaller, most closely resembles the Recent *B. exustus* (Linné) (Systema Naturae, ed. 10, p. 705, 1758). This species has practically the same sculpture, also a steep ventral margin, and a sharp umbonal ridge.

Occurrence. — Point Courbaril: K 12255, PJ 212, USGS 20432, USGS 20432a, USGS 20433, USGS 20434. Matura Bay: K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Genus **MODIOLUS** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 87.

Type species (by monotypy), *Mytilus modiolus* Linné.

According to Opinion 325 (Opinions and Declarations rendered by the International Comm. Zool. Nomenclature, vol. 9, pt. 16, pp. 251-266, 1955) *Modiolus* Lamarck is a *nomen conservandum*, and *Volsella* Scopoli, 1777, is suppressed.

Modiolus cf. **americanus** (Leach)

There is a single, incomplete left valve from Matura which might be conspecific with *M. americanus* (Leach) (Zool. Misc., vol. 2, p. 32, pl. 72, fig. 1, 1815). The position of the beak, the ligament, and the anterior curvature are the same as in the Recent species. According to the only sculptural element, the growth lines, the general outline is the same as well. The Matura shell, however, has a thicker and heavier shell than all the Recent specimens at hand. The greatest length of the Matura fragment measures 36 mm.

Occurrence. — RR 230.

Family **PINNIDAE**

Genus **ATRINA** Gray

Gray, 1842, Synopsis of the contents of the British Museum, ed. 44, p. 83.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 199), *Pinna nigra* Dillwyn (= *Pinna vexillum* Born).

Atrina species

This genus is represented from the Melajo Clay by a few poor fragments of the anterior portion of the shell. There is no longitudinal sulcus. The observable sculpture consists of longitudinal ribs dorsally and oblique waves ventrally.

Occurrence. — PJ 285.

Family **PLICATULIDAE**Genus **PLICATULA** Lamarck

Lamarck, 1801, *Système des animaux sans vertèbres*, p. 132.

Type species (by monotypy), *Plicatula gibbosa* Lamarck.

As already stated by Dall [1890-1903 (1898), p. 761], *P. gibbosa* was the only species mentioned by Lamarck when he described the genus. Thus *Plicatula* is monotypic.

Plicatula gibbosa Lamarck

Pl. 19, figs. 1, 2

1801. *Plicatula gibbosa* Lamarck, *Système des animaux sans vertèbres*, p. 132.
 1819. *Plicatula ramosa* Lamarck, *Histoire naturelle des animaux sans vertèbres*, vol. 6, p. 184 (*gibbosa* arbitrarily changed into *ramosa*).
 1873. *Plicatula vexillata* Guppy, *Proc. Sci. Assoc. Trinidad*, vol. 2, p. 86, pl. 2, fig. 7; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, p. 70.
 1874. *Plicatula vexillata* Guppy, *Guppy, Geol. Mag.*, new ser., decade 2, vol. 1, p. 436, pl. 17, fig. 7.
 1925. *Plicatula gibbosa* Lamarck, Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 91, pl. 11, figs. 4, 5.
 1964. *Plicatula gibbosa* Lamarck, Weisbord, *Bull. Amer. Paleont.*, vol. 45, No. 204, p. 113, pl. 10, figs. 10-13. For further citations see this publication.

The Matura specimens of this species are indistinguishable from Recent shells. The outline and the size of the attachment area vary considerably. The general form is subtrigonal to subcircular. Matura specimens are not smaller than Recent ones as they may attain a height of 28 mm.

P. marginata Say (1824, p. 136, pl. 9, fig. 4) and *P. densata* Conrad (1843, p. 311), both North American Miocene species, mainly differ from *P. gibbosa* by their coarser plications. *P. guppyi* Woodring (1925, p. 78, pl. 9, figs. 9-11) from Bowden, Jamaica, is said to be a smaller species than *P. gibbosa* with more distinctly foliaceous ribs.

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — See Weisbord (1964, p. 117).

Family **PECTINIDAE**Genus **PECTEN** Müller

Müller, 1776, *Zoologiae Danicae Prodomus*, . . . p. 248.

Type species (by subsequent designation, Schmidt, 1818, *Versuch über die beste Einrichtung* . . ., Gotha, pp. 67, 177), *Ostrea maxima* Linné.

Subgenus **PECTEN** s. str.**Pecten (Pecten) archon** Maury

Pl. 19, figs. 3, 4

1910. *Pecten crasicardo* Conrad, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 13; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 155. Not of Conrad.
1925. *Pecten (Pecten) archon* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 84, pl. 16, figs. 2, 3, 5.
1938. *Pecten (Pecten) archon* Maury, Vokes, American Museum Novitates, No. 988, p. 2.
1942. *Pecten (Notovola) archon* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 113, pl. 4, fig. 1.

Lectotype (herewith selected). — Paleont. Research Inst., Ithaca, N.Y., No. 798 (specimen figured by Maury, 1925, pl. 16, fig. 2).

Dimensions of lectotype. — Length 63.7 mm, height 53 mm (incomplete).

Type locality. — Springvale Quarry, Trinidad.

This species is represented from the base of the Melajo Clay by one right and several left valves. They are indistinguishable from topotypes. Rutsch (1942, p. 114) compared *P. archon* with related species.

P. archon has been assigned by Rutsch to the subgenus *Notovola* Finlay (1926, p. 451), type species, *Pecten novaezelandiae* Reeve. *Notovola*, however, is considered as a synonym of *Pecten* s. str. by Fleming (1957, p. 18). In *Euvola* Dall [1890-1903 (1898), p. 694], type species, *Ostrea ziczac* Linné, the radial sculpture is much weaker and the interspaces of the ribs reduced to grooves, whereas *Pecten maximus* (the type species of *Pecten*) has strong radial sculpture. On the other hand *P. archon* lacks secondary riblets on the primary radials and their interspaces, which are typical in *P. maximus*. It has only a medial groove on the radials near the ventral margin of adult specimens, which approaches it again in *P. ziczac*.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm..

Genus **AEQUIPECTEN** Fischer

Fischer, 1886, Manuel de Conchyliologie, p. 944.

Type species (by monotypy), *Chlamys opercularis* (Linné).

Subgenus **PLAGIOCTENIUM** Dall

Dall, 1898, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 4, p. 696.

Type species (by original designation), *Pecten ventricosus*

G. B. Sowerby II (= *Pecten circularis* Sowerby).

Aequipecten (Plagiocentrum) cf. gibbus (Linné) Pl. 19, figs. 5, 6

A few valves from Matura belong to the group of *Pecten gibbus*. The number of subspecific and varietal names of *P. gibbus* is so high that no attempt is made to compare them as this would be possible only with large series of topotypes. The Matura specimens have 20 ribs. Their concentric sculpture is inconspicuous due to washing. They mainly differ from Recent specimens by their narrower and more slender umbones and by the deeper concavity below the posterior auricle.

Maury (1925, p. 86, pl. 14, fig. 2, pl. 16, fig. 1) referred her shells from Matura without hesitation to *A. gibbus* stating that *Pecten nucleus* Born, cited by Guppy from Matura, probably represents this species.

According to Mansfield (1936, p. 182) *A. gibbus* ranges from Pliocene to Recent. Dall [1890-1903 (1898), p. 745] and Gardner [1943-1948 (1943), p. 31, pl. 5, fig. 3] reported *A. gibbus* from the Miocene of Virginia and North Carolina.

Occurrence. — JS 67, RR 230, USGS 18204, USGS 19860.

Aequipecten (Plagiocentrum) demiurgus (Dall) Pl. 20, figs. 1, 2

1866. *Pecten comparilis* Tuomey and Holmes, Guppy, Quart. Jour. Geol. Soc. London, vol. 22, p. 576. Not of Tuomey and Holmes, 1857.

1867. *Pecten comparilis* Tuomey and Holmes, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 164; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 43. Not of Tuomey and Holmes, 1857.

1874. *Pecten comparilis* Tuomey and Holmes, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 443. Not of Tuomey and Holmes, 1857.

1898. *Pecten (Plagiocentrum) demiurgus* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 4, p. 718, pl. 26, fig. 3.

1910. *Pecten inaequalis* Sowerby, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, pp. 7, 12; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 150, 155. Not of G. B. Sowerby I, 1850.

1925. *Pecten (Plagiocentrum) demiurgus* Dall, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 85, pl. 14, fig. 5, pl. 16, fig. 6.

1926. *Pecten demiurgus* Dall, Harris in Waring, Johns Hopkins Univ. Studies in Geology, No. 7, p. 109, pl. 20, figs. 3, 4.

1938. *Chlamys (Plagiocentrum) reedsi* Vokes, American Museum Novitates, No. 988, p. 10, fig. 7.

1942. *Chlamys (Plagiocentrum) gibbus demiurgus* (Dall), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 112, pl. 3, fig. 5.

Holotype. — USNM 115527.

Type locality. — Savanetta, Trinidad (Dall). This locality is near Philippine Estate, west of Gran Couva, Trinidad.

This species is abundant at the base of the Melajo Clay. The specimens agree with topotypes of *A. demiurgus*.

Rutsch is probably correct in suggesting that the species described from the Pliocene of Venezuela as *Pecten circularis caucanus* by Hodson and Hodson (*in* Hodson, Hodson, and Harris, 1927, p. 27, pl. 15, figs. 1, 8) is the same as *A. demiurgus*.

Occurrence. — RR 291, USGS, 18411, USGS 18634.

Distribution. — Miocene of Columbia (Anderson, 1929, p. 155)? Upper Miocene Springvale Fm. of Trinidad. Pliocene of Lower California (Grant and Gale, 1931, p. 220)?

***Aequipecten (Plagioctenium) maturensis* (Maury)** Pl. 20, figs. 3, 4
1925. *Pecten maturensis* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 89, pl. 14, figs. 3, 4.

Shell of medium size, subcircular, subequivalve. Both valves flat. Sculpture consists of about 16 smooth radials which are crossed by fine growth lines. The ribs of the left valve tend to be narrower and more elevated with correspondingly broader interspaces, whereas those of the right valve are low and rounded. Right anterior auricle produced, sculptured by five to seven radial threads. Inner margin below it with four denticles.

Lectotype (*herewith selected*). — Paleont. Research Inst., Ithaca, N.Y., No. 900 (specimen figured by Maury, 1925, pl. 14, fig. 3).

Dimensions of lectotype. — Length 33.5 mm, height 30.8 mm.

Type locality. — Matura, Trinidad.

This species is common at Matura, and the material is usually well preserved. The concentric sculpture is mostly inconspicuous due to washing.

A. thompsoni (Maury) (1917, p. 188, pl. 34, figs. 9, 10) from the Gurabo Formation of the Dominican Republic is also a flat-valved species with the same number of ribs but is smaller, and its ribs are narrower. *A. nelsoni* (Olsson) (1932, p. 82, pl. 5, figs. 3, 6) from the Tumbes Formation of northern Peru is similar and seems to differ from *A. maturensis* only by its larger size. The same seems to be true for the Venezuelan Neogene *A. coderensis* (Harris) (*in* Hodson, Hodson, and Harris, 1927, p. 34, pl. 18, figs. 2, 4, 5).

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

Aequipecten (Plagioctenium) cf. maturensis (Maury)

A few small, complete valves and a number of fragments of large specimens from the Melajo Clay are closely related to *A. maturensis*. But the material is inadequate for full description.

Occurrence. — Hutch 47, Hutch 51, K 9816, K 9817, K 9903, PJ 285, USGS 18399, USGS 21178.

Aequipecten (Plagioctenium) rutamensis, n. sp. Pl. 20, figs. 5, 6

Shell small. Valves flat to little inflated. Sculpture consists of 16 to 17 highly elevated, flat-topped or rounded ribs. Interspaces with secondary riblets on ventral half which appear somewhat earlier anteriorly. Unwashed specimens show fine, somewhat imbricated concentrics which are more conspicuous in the interspaces. Auricles unequal, sculptured by a few radials. Right anterior ear produced, with a deep notch. Inner margin below it with three to four denticles. Crura inconspicuous.

Holotype. — Natural History Museum Basel, No. G 12961.

Dimensions of holotype (right valve). — Length 14.7 mm, height 14.5 mm.

Type locality. — Matura, Trinidad.

This species is represented by more than 30 specimens. No comparable form has been found.

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Aequipecten (Plagioctenium) species

A number of specimens from the Courbaril beds seem to be intermediate between *A. maturensis* (Maury) and *A. rutamensis*, n. sp. Some valves have distant, rounded ribs like *A. maturensis*. Others have highly elevated ribs like *A. rutamensis*, n. sp., but they lack secondary riblets and have stronger concentric threads.

Occurrence. — K 1429, PJ 212, USGS 10991, USGS 20432, USGS 20434.

Genus **CYCLOPECTEN** Verrill

Verrill, 1897, Conn. Acad. Arts and Sci., Trans., vol. 10, art. 2, p. 70.

Type species (by subsequent designation, Suter, 1913, Manual of the New Zealand Mollusca, p. 880), *Pecten pustulosus* Verrill.

Cyclopecten species

Pl. 20, figs. 7, 8

A single, right valve measuring 3 mm in length and 2.8 mm in height from the Melajo Clay is at hand. Shell almost circular. The anterior auricle is larger leaving a small notch. It carries a fine radial thread. Prodissoconch white. Entire surface of shell smooth except a few inconspicuous, concentric, sculptural elements in the young stage. Near the antero-dorsal margin there is an unpronounced umbonal ridge. Inner surface and margin entirely smooth. No ctenolium.

There are several similar Miocene species which should be compared by means of topotypes. Numerous topotypes of *C. guppyi* (Dall) [1890-1903 (1898), p. 718, pl. 34, figs. 12, 13] from Bowden, Jamaica, are at hand. This species reaches a much larger size than the Melajo specimen, and it is proportionately higher. *C. aotus* (Olsson) (1922, p. 204, pl. 18, figs. 17, 18) and *C. oligolepis* (Brown and Pilsbry) (1913a, p. 512, text fig. 5) from the Gatun Formation of Costa Rica, and the Panama Canal Zone, respectively, have about the same dimensions. *C. defuniak* (Gardner) [1926-1950 (1926), p. 49, pl. 12, figs. 10-12] from the Shoal River Formation of Florida is also almost smooth. However, more material from the Melajo Clay is needed to allow reliable comparisons.

Occurrence. — K 9817.

Family **OSTREIDAE**

Some poor, indeterminable fragments and small specimens which may belong to different ostreid genera occur in the Melajo Clay.

Genus **OSTREA** Linné

Linné, 1758, Systema Naturae, ed. 10, p. 696.

Type species (by subsequent designation, Schmidt, 1818, Versuch über die beste Einrichtung . . ., Gotha, pp. 69, 177), *Ostrea edulis* Linné. (Not seen). *Fide* Gardner [1913-1948 (1943), p. 41].

Ostrea species

An *Ostrea s. str.* is represented from Point Courbaril by some large fragments. The general outline is broadly elongate to sub-

circular. Valves flat. Sculpture consists of concentric markings only. Lateral margins near the beak with some distant denticles. Muscle scar large, pear-shaped, situated on lower half.

Occurrence. — K 8399, PJ 212, USGS 21778.

Genus **CRASSOSTREA** Sacco

Sacco, 1897, I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 23, p. 15.

Type species (by original designation), *Ostrea virginica* Gmelin.

Crassostrea cf. virginica (Gmelin)

Pl. 21, fig. 7

Some fragments from Matura and Point Courbaril may belong to *C. virginica*. A strongly elongate specimen from Matura is figured.

Occurrence. — Point Courbaril: USGS 20434. Matura Bay: RR 230, USGS 19860.

Genus **LOPHA** Röding

Röding, 1798, in Museum Boltenianum, p. 168.

Type species (by subsequent designation, Dall, 1898, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 4, p. 672), *Mytilus cristagalli* Linné.

Stenzel (1947, p. 177) considered *Lopha* as a synonym of *Alectryonia*. According to the now valid International Code of Zoological Nomenclature [art. 12, art. 16 (a) (v), 1961] the contrary is the case, *i.e.* *Alectryonia* is a synonym of *Lopha* both having the same type species. Röding's citation of *O. cristagalli* (which is an available specific name) constitutes an indication.

Lopha messor (Maury)

Pl. 21, fig. 5

?1922. *Ostrea megodon* Hanley, Olsson, Bull. Amer. Paleont., vol. 9, No. 39, p. 195, pl. 18, fig. 1.

1925. *Ostrea messor* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 81, pl. 10, figs. 3, 4.

1942. *Ostrea (Lopha) messor* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 101.

Holotype. — Paleont. Research Inst., Ithaca, N.Y., No. 962.

Type locality. — Springvale Quarry, Trinidad.

This species is represented by a single fully grown valve from the lower part of the Melajo Clay. It has five sharp plications and

some inconspicuous denticles on the lateral margin near the beak. The curving growth seems to be typical. The specimen agrees with material from the type area of the Springvale Formation.

The Recent West Coast *L. megodon* (Hanley) (1845b, p. 106) is a larger species, and its plications are less sharp according to Olsson's figures (1961, pl. 23, figs. 3, 3a). *L. paramegodon* (Woodring) (1925, p. 60, pl. 6, figs. 12-14) from Bowden, Jamaica, has even less accentuated plications.

Occurrence. — Hutch 51.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad. Gatun Fm. of Costa Rica?

Family ANOMIIDAE

Genus ANOMIA Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 700.

Type species (by subsequent designation, Gray, 1847, *Zool. Soc London, Proc.*, pt. 15, p. 201) *Anomia ephippium* Linné.

Anomia simplex d'Orbigny

Pl. 21, fig. 6

- 1842. *Anomia simplex* d'Orbigny in La Sagra, *Histoire physique, politique et naturelle de l'Ile de Cuba*. Atlas, pl. 28, figs. 31-33.
- 1845. *Anomia simplex* d'Orbigny in La Sagra, *Historia fisica, politica y natural de la Isla de Cuba*. Segunda parte. Historia natural, vol. 5, Moluscos, p. 371.
- 1922. *Anomia simplex* d'Orbigny, Olsson, *Bull. Amer. Paleont.*, vol. 9, No. 39; p. 209, pl. 21, fig. 6.
- 1925. *Anomia simplex* d'Orbigny, Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 92, pl. 12, fig. 8.
- 1932. *Anomia simplex* d'Orbigny, Mansfield, *Florida State Geol. Sur., Bull.* No. 8, p. 67, pl. 13, fig. 2.
- 1938. *Anomia simplex* d'Orbigny, Vokes, *Amer. Museum Novitates*, No. 988, p. 11.
- 1942. *Anomia* aff. *simplex* d'Orbigny, Rutsch, *Verh. Naturf. Ges. Basel*, vol. 54, p. 101.
- 1951. *Anomia simplex* d'Orbigny, McLean, *New York Acad. Sci., Sci. Sur. Porto Rico Virgin Islands*, vol. 17, pt. 1, p. 37, pl. 8, fig. 2.
- 1953. *Anomia simplex* d'Orbigny, Olsson and Harbison, *Acad. Nat. Sci. Philadelphia, Mon.*, No. 8, p. 61.
- 1954. *Anomia simplex* d'Orbigny, Abbott, *American Seashells*, p. 372, pl. 35 k.
- 1961. *Anomia simplex* d'Orbigny, Warmke and Abbott, *Caribbean Seashells*, p. 172, pl. 34 h.

This species is represented by left valves only. The shells from Matura are small (16-18 mm in height) and not abundant. The shell from Matura figured by Maury measures 26 mm in height.

A specimen clearly showing the three muscular impressions is figured.

Matura shells closely resemble the form described as *A. indecisa* Dall [1890-1903 (1898), p. 783; Woodring, 1925, p. 84, pl. 10, figs. 6-9] from Bowden, Jamaica. Outline, size, and position of the muscle scars are the same. Size and position of the scars, however, are variable. The two lower scars may be almost as large as the upper one, and the distances between them are not constant. A case, where the position of the scars is inverted, occurs in the Melajo Clay: the large scar is situated below the two smaller scars.

Specimens from the Courbaril beds are larger than those from Matura (about 25 mm in length). But the largest shells occur in the Melajo Clay. An incomplete specimen measures more than 50 mm in height and over 60 mm in length.

Rutsch (1942, p. 101) listed *A. aff. simplex* from the type area of the Springvale Formation. In a private report he separated the Springvale form from the Recent species because of its larger size and thicker shell. Melajo specimens of the same size as Recent ones have about the same thickness of the shell.

Occurrence.—Melajo River area: Hutch 47, Hutch 51, KR 11862, K 9813, K 9817, K 9903, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 1429, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778. Matura Bay: RR 230, USGS 18204.

Distribution.—Miocene to Recent.

Family CRASSATELLIDAE

Genus EUCRASSATELLA Iredale

Iredale, 1924, Linnean Soc. New South Wales, Proc., vol. 49, p. 202.

Type species (by original designation), *Crassatella kingicola* Lamarck.

Eucrassatella trinitaria (Maury)

Pl. 21, figs. 1-4

1911. *Crasatela* [sic] *melina* Conrad, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 454, p. 5; not p. 8: = *E. montserratensis* (Maury); reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 161; not p. 164.

1925. *Crassatellites* (*Scambula*) *trinitarius* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 175, pl. 31, figs. 1, 7.

1942. *Eucrassatella trinitaria* (Maury), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 102.

Shell of medium size, elongate, moderately inflated. Umbones flattened. Beaks weakly prosogyrate. Lunule and escutcheon depressed. Anterior end rounded, posterior end produced. Adult specimens with two feeble posterior umbonal ridges. Sculpture consists of about seven wavelike concentric ridges near the beaks, ventrally of fine concentrics. Hinge of both valves with two cardinals. The right posterior, the left anterior, and the anterior side of the left posterior have lateral crenulations. Left hinge with an anterior and a posterior lateral tooth. Right hinge not sufficiently preserved. Muscle scars deep. Pallial line simple. Ventral margin smooth.

Lectotype (herewith selected). — Paleont. Research Inst., Ithaca, N.Y., No. 998 (specimen figured by Maury, 1925, pl. 31, fig. 7).

Dimensions of lectotype. — Length 52.2 mm, height 32.4 mm, convexity (both valves) 17.3 mm.

Type locality. — Springvale Quarry, Trinidad.

This species is well represented from the Melajo Clay. *E. trinitaria* is easily distinguished from *E. montserratensis* (Maury) (1925, p. 176, pl. 31, fig. 3), with which it is associated at its type locality, by its more elongate shape. *E. montserratensis* has less and coarser concentric ridges on the umbones and is more inflated. *E. venezuelana* (F. Hodson) (in Hodson, Hodson, and Harris, 1927, p. 45, pl. 28, figs. 2, 6, 9) from the middle Miocene of Falcón, Venezuela, is a proportionately shorter, higher, and more inflated species.

Occurrence. — Hutch 51, K 9902, USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Genus **CRASSINELLA** Guppy

Guppy, 1874, Geol. Mag., new ser., decade 2, vol. 1, p. 442.

Type species (by monotypy), *Crassatella martinicensis* d'Orbigny.

Crassinella martinicensis (d'Orbigny)

Pl. 22, figs. 1, 2

1842. *Crassatella martinicensis* d'Orbigny in La Sagra, Histoire physique, politique et naturelle de l'Île de Cuba. Atlas, pl. 27, figs. 21-23.

1845. *Crassatella martinicensis* d'Orbigny, in La Sagra, Historia física, política y natural de la Isla de Cuba. Segunda parte, vol. 5, Moluscos, p. 325.

1864. *Astarte (Gouldia) martinicensis* d'Orbigny, Guppy, Trans. Sci. Assoc.

- Trinidad for 1864, p. 36; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 16.
1867. *Gouldia martinicensis* d'Orbigny, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.
1874. *Crassinella martinicensis* d'Orbigny, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442.
1875. *Crassinella martinicensis* d'Orbigny, Guppy, Geol. Mag., new ser., decade 2, vol. 2, p. 42.
1925. *Crassinella guadalupensis* d'Orbigny, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 177, pl. 31, figs. 4, 6.
1925. *Crassinella martinicensis* d'Orbigny, Maury, *ibidem*, p. 178, pl. 31, fig. 2.
- ?1956. *Crassinella martinicensis* (d'Orbigny), Parker, Amer. Assoc. Petr. Geol., Bull., vol. 40, No. 2, p. 329, pl. 2, figs. 12A, 12B.
1961. *Crassinella martinicensis* d'Orbigny, Warmke and Abbott, Caribbean Seashells, p. 173.

Shell small. General outline trigonal, equilateral to inequilateral. Valves usually higher than long. Inflation variable. Sculpture consists of a varying number of concentric ridges; their development ranges from lamellar to rounded. An inconspicuous, shallow, radial depression near the postero-dorsal margin may be present.

Type locality. — Martinique (Recent).

The separation of the two Recent species *C. martinicensis* and *C. guadalupensis* is based on differences of the symmetry and inflation of the valves as well as on the regularity of the concentric ridges. A number of rich samples of Recent specimens from the Gulf of Paria, Trinidad, suggests that they represent one strongly variable species. Many transitional forms can be found in one lot; from equilateral to strongly inequilateral; many degrees of inflation. The concentric ridges are mostly lamellar, but rounded ones occur as well. Their number and the width of their interspaces are not constant. If the identity of *C. martinicensis* and *C. guadalupensis* can be shown to be true by a study of rich topotype material, the name *martinicensis* will have to be used as it has page priority. The Recent *Thetis parva* C. B. Adams (1845, p. 9; Clench and Turner, 1950, p. 322, pl. 44, figs. 5, 6) from Jamaica is the same as *C. guadalupensis*.

An analogue "pair of species" is known from the Pacific Coast of America: *C. pacifica* (C. B. Adams) (1852, p. 499) and *C. mexicana* Pilsbry and Lowe (1932, p. 103, pl. 14, figs. 8, 9). The lectotype of *C. pacifica* has been figured by Turner (1956, pl. 20, figs. 3, 4).

C. martinicensis is represented from Matura by hundreds of specimens. They show exactly the same variability as the Recent material.

The typical feature of *C. clementia* Pilsbry and Olsson (1941, p. 56, pl. 12, fig. 8) from the Pliocene of western Ecuador is its almost smooth surface near the ventral margin. Analogue specimens can be found (although rarely) in the Recent material from the Gulf of Paria.

Topotype material of *C. guppyi* (Dall) (in Guppy and Dall, 1896, p. 326, pl. 30, fig. 5) from Bowden, Jamaica, shows that this species is longer than high, and the shallow, radial depression near the posterior margin is frequently (but not always) developed. Bowden specimens are difficult to separate from Matura shells. In fact Dall [1890-1903 (1903), p. 1476] thought them to be conspecific.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18201, USGS 19860.

Distribution. — Recent, West Indies.

Crassinella guppyi (Dall)

Pl. 22, figs. 3, 4

- 1896. *Crassatellites* (*Crassinella*) *guppyi* Dall, (in Guppy and Dall), U. S. Nat. Mus., Proc., vol. 19, p. 326, pl. 30, fig. 5.
- 1903. *Crassatellites* (*Crassinella*) *guppyi* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 6, p. 1476 (part).
- 1910. *Crasinella guppyi* (sic) Dall, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 7; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 149.
- ?1917. *Crassinella guppyi* Dall, Maury, Bull. Amer. Paleont., vol. 5, No. 29, p. 197, pl. 26, fig. 21.
- ?1922. *Crassatellites* (*Crassinella*) *guppyi radiata* Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., vol. 73, p. 415, pl. 38, fig. 4.
- 1925. *Crassinella guppyi* Dall, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 177, pl. 31, fig. 5.
- 1925. *Crassinella guppyi* (Dall), Woodring, Carnegie Inst. Washington, Pub. 366, p. 96, pl. 11, figs. 18-20.
- 1942. *Crassinella guppyi plana* Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 115, pl. 3, figs. 6, 7.

Holotype. — Of *guppyi*: USNM 107151; of *guppyi radiata*: Acad. Nat. Sci. Philadelphia, No. 3994; of *guppyi plana*: Natural History Museum Basel, No. G 2541.

Type locality. — Of *guppyi*: Bowden, Jamaica; of *guppyi radiata*: Miocene, Dominican Republic; of *guppyi plana*: Springvale Quarry, Trinidad.

The above synonymy is based on a rich material from the Melajo Clay, numerous topotypes of *C. guppyi*, and the type material of *C. guppyi plana*. As stated by Woodring (1925, p. 211) and Rutsch (1942, p. 115) specimens from the Savaneta Glauconitic Sandstone Member of the Springvale Formation are flatter than those from Bowden, and have fewer concentrics, but the Melajo material shows a variability embracing both extremes. There are paratypes of *C. guppyi plana* which are much more inflated than the holotype and which carry more concentrics. The separation of this subspecies seems artificial. The variability shown by the Melajo specimens is analogous to that of Recent shells of *C. martinicensis* from the Gulf of Paria and the rich material from the Pliocene of Matura Bay. In fact it is difficult to separate Melajo shells from Matura specimens. The Melajo valves, like those from Bowden, tend to be longer than high. But this separation is not satisfactory.

C. guppyi radiata from the Miocene of the Dominican Republic is tentatively placed in the synonymy of *C. guppyi*. Its distinguishing feature, the fine radial striation, can be observed on somewhat worn specimens from the Melajo Clay as well. The same can be seen in Recent specimens of *C. martinicensis*.

A number of similar Miocene and Pliocene North American and Central American species of *Crassinella* have been described. Their relations should be studied with topotype material as some of them are insufficiently figured. They include *C. acuta* (Dall) [1890-1903 (1903), p. 1479, pl. 50, figs. 1, 4], *C. cahuitensis* Van Winkle (1923, p. 12, pl. 2, fig. 2), *C. lunulata* (Conrad) (1831, p. 133), *C. midiensis* (Olsson) (1922, p. 213, pl. 29, fig. 11), *C. profundorum* Pilsbry and Harbison (1933, p. 117, pl. 4, figs. 22, 23), and others.

Occurrence. — Melajo River area: EL 1810, KR 11862, K 9817, K 9902, K 9903; RR 293, PJ 285, USGS 18399, USGS 21178. Point Courbaril: RR 120 (rare).

Distribution. — Miocene, Dominican Republic ?, Bowden Fm., Jamaica. Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., and Courbaril beds of Upper Morne l'Enfer Fm., Trinidad.

Family CARDITIDAE

Genus **CARDITAMERA** Conrad

Conrad, 1838, Fossils of the Medial Tertiary of the United States, p. 11.

Type species (by subsequent designation, Dall, 1903, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 6, p. 1408), *Cypri-cardia arata* Conrad.

Subgenus **CARDITAMERA** s. str.**Carditamera (Carditamera) guppyi** (Dall)

Pl. 22, figs. 5-7

1867. *Cardita minima* "Sowerby", Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 42. Not of Reuss 1844; see Dall, 1903, p. 1413.
1874. *Cardita minima* Sowerby, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442. Not of Reuss, 1844.
1903. *Cardita (Carditamera) guppyi* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 6, p. 1413, pl. 56, fig. 3.
1925. *Cardita (Carditamera) guppyi* Dall, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 170.

Shell small, elongate. Beaks situated well anteriorly. Sculpture consists of about 14 radials which are strongest on the posterior umbonal ridge. Interspaces narrower, crossed by growth lines. Ribs with transversely elongated nodes which are usually stronger and higher on posterior half of shell. Right hinge with two cardinals and a posterior lateral tooth. Anterior cardinal strong, its base extended along lower margin of hinge plate. Posterior cardinal narrow, inconspicuous. Left hinge with two subequal cardinals and an anterior lateral. Socket for right posterior lateral tooth prominent. Inner margin fluted, strongest postero-ventrally.

Lectotype. — USNM 115668 (specimen figured by Dall).

Type locality. — Matura, Trinidad.

Guppy listed this species not only from Matura, where it is abundant, but also from the Recent fauna. The latter needs confirmation. *C. guppyi* shows some variability. When typical the shells are strongly inflated and have a broad posterior umbonal ridge. Some specimens, however, are less inflated, and the umbonal ridge is narrower, thus having a different appearance. As intergrading forms are present they are thought to belong to the same species.

The presence of an inconspicuous posterior cardinal in the right hinge is surprising and does not fit the generic definition.

C. guppyi belongs to the group of *C. arata* (Conrad) (see

Olsson and Harbison, 1953, p. 74) from the Miocene and Pliocene and *C. floridana* (Conrad) (1838-1845, p. 12, 1838) from the Pliocene and Recent fauna of the southeastern United States but is much smaller. *C. catharia* (Dall) [1890-1903 (1903), p. 1416, pl. 56, fig. 1], from the Caloosahatchee Pliocene of Florida, is also a small species but has many more ribs and is more elongate.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

Carditamera (Carditamera) species

Pl. 22, figs. 8, 9

Shell small, elongate. Ventral margin straight, postero-ventrally produced. Beaks low, situated well anteriorly. Sculpture consists of 15 ribs with narrower interspaces. Anterior ribs beaded, posterior ones crossed by some growth lines which give an imbricated appearance. Lunule depressed. Right hinge with one cardinal which is extended along the lower margin of the hinge plate. It is bordered by a triangular socket anteriorly and a narrow, long socket posteriorly. One right posterior lateral. Socket for left anterior lateral conspicuous. Inner margin coarsely fluted.

This species is represented by two right valves only; one from Point Courbaril, the other from the Melajo Clay. Maury (1912, p. 53, pl. 9, figs. 2, 3) described *C. virginiae* from a locality just south of the Pitch Lake, Trinidad. This locality yields only molds, and the hinges are not preserved. Although the specimens from Point Courbaril and the Melajo River area have the same external sculpture, general outline, and size as Maury's species, it seems best to treat *C. virginiae* as a *nomen dubium*. The lectotype of *C. virginiae* is here selected and figured (Pl. 22, fig. 10).

Occurrence. — Melajo River area: K 9816. Point Courbaril: K 8399.

Subgenus **BYSSOMERA** Olsson

Olsson, 1961, Panamic-Pacific Pelecypoda, Paleont. Res. Inst., p. 189.

Type species (by original designation), *Cardita affinis* G. B. Sowerby I.

Carditamera (Byssomera) aff. affinis (G. B. Sowerby I) Pl. 22, figs. 11, 12

This species occurs in the Courbaril beds. The specimens

measure 30 to 35 mm in length. According to Olsson (1961, p. 189) the Recent West Coast *C. affinis* (G. B. Sowerby I) (*in* Broderip and Sowerby, 1832-1833, p. 195, 1833) reaches a much larger size. It is said to be strongly variable as to size, shape, and sculpture.

The Trinidad shells have about 16 ribs; those on the posterior umbonal ridge are large, the central ones flattened and but weakly sculptured, and the anterior ones narrow and crossed by conspicuous incrementals. Beaks situated even more anteriorly than in *C. affinis*. The antero-dorsal margin is steeper. Lunule small, but distinct, and deeply impressed. Anterior margin strongly curved. Hinge almost identical with that figured by Olsson (1961, pl. 26, fig. 3). Anterior and posterior inner margins strongly fluted. Muscle scars deeply impressed.

The Recent Caribbean *C. gracilis* (Shuttleworth) (1856, p. 173) is strongly angulated postero-dorsally; it is less constricted anteriorly, and its central ribs seem to be less flattened than in *C. aff. affinis*. *C. gracilis* has also been recorded from the Pliocene of Venezuela by Weisbord (1964, p. 200, pl. 26, figs. 3-17).

Less closely related than *C. affinis* is *C. verdevilla* Gardner [1943-1948 (1943), p. 69, pl. 15, figs. 5, 6] from the Miocene of North Carolina. This species was originally described as a subspecies of *C. arata* (Conrad) (see Olsson and Harbison, 1953, p. 74), but it seems to belong to the subgenus *Byssomera*. The central ventral sinus is weak, and the anterior portion of the shell less contracted than in the Trinidad valve.

Occurrence. — K 8399, USGS 20432, USGS 20432a, USGS 21778.

Family **CONDYLOCARDIIDAE**

Genus **CONDYLOCARDIA** Bernard

Bernard, 1897, Jour. de Conchyliologie, vol. 44 (ser. 3, vol. 36), p. 174. For date of publication see Winckworth, 1936, Malac. Soc. London, Proc., vol. 22, p. 156.

Type species (by original designation), *Condylocardia sanctipauli* Munier Chalmas (= *Condylocardia pauliana* Bernard). See Lamy, 1922, Jour. de Conchyliologie, vol. 66 (ser. 4, vol. 20), p. 363.

Condylocardia guppyi (Maury)

Pl. 23, figs. 1-4

1925. *Erycinella (Carditopsis) guppyi* Maury, Bull. Amer. Palcont., vol. 10, No. 42, p. 172, pl. 27, fig. 14.

Shell minute, strongly inflated, subrectangular. Beaks situated

well anteriorly. Behind the umbones there is a broad and slightly concave escutcheon. Prodissoconch prominent, with inconspicuous radial striae, bordered by a thickened, rounded margin. External sculpture consists of 12 radials with deep, narrow interspaces. The penultimate rib is smaller, the posteriormost interspace broader than the others. Ribs with nodes which may become foliaceous especially on posterior slope. Left hinge consists of a cardinal on each side of the resiliary pit, an anterior marginal lateral tooth, and a prominent posterior lateral tooth which is separated from the margin by a deep socket. Right hinge with a well-developed cardinal in front of the resiliary pit, a weak anterior lamina, an incomplete posterior cardinal, a marginal posterior lateral, and an anterior lateral tooth separated from the margin by a socket. Inner margin fluted ventrally. Muscle scars small.

Holotype. — Paleont. Research Inst., Ithaca, N.Y., No. 959.

Type locality. — Matura, Trinidad.

This is a rare species; it is represented only by a few specimens from Matura.

The type of *C. bernardi* (Dall) [1890-1903 (1903), p. 1438, pl. 53, fig. 10], a right valve (USNM 135637) from the Pliocene of Limón, Costa Rica, is glued to a card showing the exterior. The original figure shows the interior. *C. guppyi* is easily distinguished from *C. bernardi* by its longer postero-dorsal margin, *i.e.* it is more inequilateral. *C. bernardi* is about as long as high and has more ribs with shallower interspaces. *C. bernardi* has also been recorded from the Recent fauna of the Caribbean coast of Panama by Olsson and McGinty (1958, p. 52, pl. 5, fig. 6).

The collections of the U.S. National Museum contain a broken specimen from USGS station 18249: Pliocene of Cabo Blanco, Venezuela, which may represent immature *C. bernardi*.

The distribution of fossil and Recent species of *Condylocardia* has been outlined briefly by Hertlein and Strong (1948, p. 106).

Occurrence. — JS 67, RR 230, USGS 19860.

Distribution. — Known from type locality only.

Family LUCINIDAE

Genus LUCINA Bruguière

Bruguière, 1797, Encycl. Méth., Tabl. Vers, pls. 284, 285, 286. For date of

publication see Sherborn and Woodward, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 579.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 195), *Venus jamaicensis* Spengler (= *Tellina pectinata* Gmelin).

Subgenus **LUCINA** s. str.

Lucina (Lucina) cf. pectinata (Gmelin)

This form is represented from Matura by a single right, incomplete valve. Comparison with Recent specimens of *L. pectinata* shows that the Matura specimen has a shorter but broader lunule. Otherwise they are identical.

L. pectinata occurs from the southeastern United States through the West Indies south to Uruguay. It is also known from the Pliocene of Florida.

Occurrence. — RR 230.

Subgenus **LUCINISCA** Dall

Dall, 1901, U. S. Nat. Mus., Proc., vol. 23, No. 1237, p. 805.

Type species (by original designation), *Lucina nassula* Conrad.

Lucina (Luciniscia) roigi (Maury)

Pl. 23, figs. 5-11

1867. *Lucina muricata* Chemnitz, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.

1874. *Lucina muricata* Chemnitz, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442.

1925. *Phacoides (Luciniscia) roigi* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 167, pl. 29, fig. 6.

Shell of small to medium size, subcircular, usually somewhat truncated posteriorly. Umbones situated centrally. Sculpture consists of some concentric lamellar ridges in young stages and of radial ribs. Concentrics inconspicuous in the adult. Radials 20 to 40 carrying hollow scales. On the posterior slope there is one wide interspace which is smooth or carries three or four fine radial riblets. Left hinge with two cardinals, and an anterior and a posterior pair of lateral teeth, the dorsal one of each is smaller. Right hinge with three cardinals; the middle one is well developed, the others rudimentary, and an anterior and posterior lateral tooth. Lunule small. Anterior muscle scar elongate. Pallial line simple. Inner margin with fine crenulations.

Holotype. — Paleont. Research Inst., Ithaca, N.Y., No. 977.

Type locality. — Matura, Trinidad.

This species is rare at Matura. It is represented by a few valves only, the largest one measuring 17.1 mm in length and 15.7 mm in height.

In contrast to Matura *L. roigi* is abundant in the Melajo River area and at Point Courbaril. These specimens tend to be higher than long, but this is not a rule. Also they usually have some more radials than Matura shells, but otherwise they are identical.

Weisbord (1964, p. 224) questionably included *L. roigi* in the synonymy of the Recent *L. muricata* (Spengler). Although these two species are most closely related, *L. roigi* may be distinguished by its less numerous radials which usually carry more conspicuous hollow vaulted scales. This is especially true for specimens from the Melajo Clay.

The Recent Pacific Coast *L. liana* (Pilsbry) (1931, p. 435, pl. 41, fig. 3), which has also been reported from the Pliocene Canoa Formation of western Ecuador, and *L. fausta* Pilsbry and Olsson (1941, p. 58, pl. 17, figs. 3, 6), also from the Pliocene Canoa Formation of western Ecuador, possibly represent one species. They are considerably larger than *L. roigi*, and their radials are arranged differently. In *L. arrogans* Olsson (1964, p. 49, pl. 7, fig. 3) from the middle Miocene Angostura Formation of northwestern Ecuador the radials are finer and the concentric sculptural element more pronounced.

Occurrence. — Melajo River area: EL 1810, Hutch 47, Hutch 51, KR 11862, K 9797, K 9813, K 9816, K 9817, K 9903, RR 290, RR 293, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, K 8399, K 12255, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778. Matura Bay: JS 67, RR 230, PJ 302, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Family **CHAMIDAE**

Genus **CHAMA** Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 691.

Type species (by subsequent designation, Schumacher, 1817, *Essai d'un nouveau système des habitations des vers testacés*, p. 123). *Chama gryphoides* Linné.

Chama cf. *macrophylla* Gmelin

Pl. 24, figs. 1, 2

This form is represented from Point Courbaril by a number of small and a few apparently adult right (unattached) valves. Some left valves are cemented together on a piece of oyster shell. These specimens show the two most characteristic features of *C. macrophylla*: the crenulations of the inner margins, and the pallial line which joins the anterior muscle scar anteriorly and not ventrally. The right valves are subcircular, and their sculpture consists of concentric, foliated lamellae.

According to Woodring (1925, p. 104) *C. macrophylla* ranges from Miocene to Recent.

Occurrence. — K 1429, K 8399, K 12013, K 12255, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778.

Chama spec. ind.

This genus is represented from Matura by a few right (unattached) valves. Their sculpture consists of concentric lamellae and radial foliations resembling worn specimens of the Recent Caribbean *C. macrophylla* Gmelin.

This probably is the form listed by Guppy (1864, p. 36; reprint, Harris, 1921, p. 16) as *Chama macrophylla* Chemnitz in his report on the Matura fossils, but the material at hand is too meager to allow a definite determination.

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Genus PSEUDOCHEMA Odhner

Odhner, 1917. Kungl. Svenska Vetenskaps-akademiens Handlingar, vol. 52, No. 16, pp. 28-31.

Type species (by subsequent designation, Gardner, 1926, U.S. Geol. Sur., Prof. Paper 142-B, p. 92), *Chama cristella* Lamarck

Pseudochama aff. *caloosana* (Dall)

Pl. 23, fig. 12-14

1867. *Chama ruderalis* Lamarck, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 42.

1874. *Chama ruderalis* Lamarck, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442.

1903. *Chama caloosana* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 6, p. 1402 (part), not pl. 54, figs. 2, 5.

There are more than 20 specimens of this form from Matura. They possibly represent immature *P. radians* Lamarck, but the lack

of unworn Recent specimens does not allow a reliable comparison. Weisbord (1964, p. 245) recorded *P. radians* from the Pleistocene of Venezuela.

In many respects, however, the Matura shells resemble *P. caloosana* (Dall) from the Pliocene of Florida but differ in the following points: they only reach about half the size of the Florida species, and there is no divaricate surface sculpture on the left valve. The Matura shells have smaller foliations, and the sulcus near the posterior dorsal border is present but not conspicuous. The inner margins are not crenulated. The surface behind the attachment area usually is smooth or crossed by a few growth lines. The left valve is not subquadrate but rather subcircular.

The prodissoconch is smooth except for a few distant, concentric markings. The size of the attachment area is variable. In some shells it occupies the entire anterior half of the shell, in others, however, the antero-ventral margin becomes free soon, in which case conspicuous foliations may be developed.

Like *P. draconis* (Dall) [1890-1903 (1903), p. 1399, pl. 56, figs. 17, 18] from the Chipola Formation of Florida, the Matura species tends to form radial rows of large foliations but lacks the finer sculpture of that species.

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Family **CARDIIDAE**

Genus **TRACHYCARDIUM** Mörch

Mörsch, 1853, *Catalogus Conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea, Comes de Yoldi*, pt. 2, p. 34.

Type species (by subsequent designation, von Martens, 1870, Zool. Rec. for 1869, vol. 6, p. 586), *Cardium isocardia* Linné.

Sugbenus **DALLOCARDIA** Stewart

Stewart, 1930, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 3, p. 264.

Type species (by original designation), *Cardium quadragenarium* Conrad.

Trachycardium (Dallocardia) sanctidavidis (Maury) Pl. 24, figs. 3-7

1867. *Cardium muricatum* Linné, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 42.

1874. *Cardium muricatum* Linné, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442.

1925. *Cardium (Trachycardium) sanctidavidis* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 129, pl. 22, fig. 3.

Shell of medium size, subcircular, thin, almost equilateral. Sculpture consists of about 40 ribs. Posterior umbonal ridge inconspicuous. The radials behind it (about 10) are flattish, sometimes grooved, with some minute nodules on their posterior edge. Anterior ribs narrower than central ones, with spiny nodes ventrally which are mostly situated on the anterior part of the rib. Hinge with two cardinals bordering a deep socket, one of them projecting. The two laterals almost symmetrically placed. Interior fluted.

Holotype. — Paleont. Research Inst., Ithaca, N. Y., No. 891.

Type locality. — Matura, Trinidad.

This species is represented from Matura by about 40 specimens. They are almost indistinguishable from specimens of the same size of the Recent *T. muricatum* (Linné) (*Systema Naturae*, ed. 10, p. 680, 1758; Clench and Smith, 1944, p. 7, pls. 1,5). But adult valves are much larger than the Matura shells and more inequilateral. Other differences have been pointed out by Maury. *T. muricatum* has also been reported from the Pliocene of Florida (Olsson and Harbison, 1953, p. 101). *T. bowdenense* (Dall) [1890-1903 (1900), p. 1087] from Bowden, Jamaica, essentially is a smaller species than *T. sanctidavidis*. *T. oedaliium* (Dall) [1890-1903 (1900), p. 1088; Olsson and Harbison, 1953, p. 101, pl. 10, fig. 6] from the Pliocene of Florida has less radials with stronger sculpture. Topotypes of *T. couvense* (Maury) (1925, p. 128, pl. 23, fig. 12) from Springvale Quarry, Trinidad, have less nodes, are more inflated, and their valves are less high proportionately.

There are a number of other similar species like *T. oedaliium harveyense* (Mansfield) (1932a, p. 110, pl. 23, figs. 9-11) from the upper Miocene of Florida, *T. tintinnabularum* (Maury) (1917, p. 210, pl. 36, fig. 3) from the Cercado Formation of the Dominican Republic, and *T. quadragenarium* (Conrad) (1837, p. 230, pl. 17, fig. 5) from California which ranges from Miocene to Recent according to Grant and Gale (1931, p. 306).

T. sanctidavidis also occurs in the Melajo Clay. Two immature specimens from the Courbaril beds are tentatively referred to this species.

Occurrence. — Melajo River area: Hutch 47, Hutch 51, USGS 18399, USGS 18411. Point Courbaril: USGS 10991 (?), USGS

20432a (?). Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm. (?), Matura shell bed.

Genus **TRIGONIOCARDIA** Dall

Dall, 1900, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 5, p. 1075.

Type species (by original designation), *Cardium graniferum* Broderip and G. B. Sowerby I.

Subgenus **TRIGONIOCARDIA** s. str.

Trigoniocardia (Trigoniocardia) maturensis (Dall) Pl. 25, figs. 1-10

1867. *Cardium haitense* G. B. Sowerby I, Guppy, Proc. Sci. Assoc. Trinidad pt. 3, p. 163; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35 p. 42.

1874. *Cardium haitense* Sowerby, Guppy, Geol. Mag., new ser., decade 2, vol 1, p. 442 (part).

1900. *Cardium (Trigoniocardia) maturense* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 5, p. 1105; *ibidem*, vol. 3, pt. 6, pl. 48, fig. 7, 1903.

?1912. *Cardium (Trigoniocardia) carolinae* Maury, Acad. Nat. Sci. Philadelphia Jour., ser. 2, vol. 15, p. 54, pl. 9, figs. 5, 6.

1925. *Cardium (Trigoniocardia) maturense* Dall, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 135, pl. 23, figs. 1, 9.

?1925. *Cardium (Trigoniocardia) carolinae* Maury, Maury, *ibidem*, p. 136.

Shell of small to medium size, high-oval, strongly inflated. Umbones high. Beaks slightly prosogyrate. Posterior umbonal ridge prominent, rounded, not angulated. Sculpture consists of about 20 ribs (average 19). Posterior slope with eight flattish ribs which are smooth or beaded to a varying degree. If there are beads, they are situated on the middle of the ribs usually. The one or two ribs marking the posterior umbonal ridge mostly carry transversely elongated, closely set nodes. The anteriormost ribs are low and flattish, smooth or beaded. Those in front of the posterior umbonal ridge are asymmetrical with the short, steep slope on the posterior side, and their nodes are restricted to the posterior part of the ribs. Interspaces crossed by threads. Hinge with two cardinals; the right posterior one and the left anterior one projecting. Anterior lateral teeth situated nearer the beaks than posterior laterals. Lunule well defined. Inner margin coarsely fluted.

Lectotype (herewith selected). — USNM 115665 (specimen figured by Dall).

Type locality. — Matura, Trinidad.

The type lot of *T. maturensis* consists of five valves. The lectotype (height 6 mm) is an immature specimen. Young shells are usually less beaded and do not have the high-oval outline of the adult, *i.e.* they are not produced postero-ventrally. *T. maturensis* is rare at Matura, whereas at Point Courbaril and in the Melajo River area, it is abundant. Matura specimens are usually strongly rolled and their nodes but poorly preserved.

Maury described her *T. carolinae* from a locality 1000 feet west of the Brighton pier, near Pitch Lake, Trinidad. This locality is attributed to the Upper Morne l'Enfer Formation like the Courbaril beds, where *T. maturensis* is abundant. A lectotype of *T. carolinae* is here selected and figured (Pl. 25, fig. 10).

T. casta (Guppy) (1866b, p. 582, pl. 26, fig. 4) from the middle Miocene Manzanilla Formation of Manzanilla Bay, Trinidad, is a much smaller species and is proportionately longer than *T. maturensis*. Immature *T. maturensis* is at once distinguishable from *T. casta* by the lack of a pronounced posterior umbonal ridge. *T. manzanillensis* (Maury) (1925, p. 133, pl. 23, fig. 4) is also smaller and proportionately longer than *T. maturensis*.

T. hannai (Olsson) (1932, p. 99, pl. 8, figs. 4, 9, 10, 11) from the lower Zorritos Formation of Peru, which has also been recorded from the middle Miocene of Ecuador and Venezuela, is a smaller species with more squarish ribs. *T. maturensis* is strikingly similar to *T. cabopasada* (Pilsbry and Olsson) (1941, p. 59, pl. 12, figs. 6, 7) from the Pliocene Jama Formation of western Ecuador in outline and proportions. But that species reaches twice the size of the Matura form and tends to have more ribs with a different cross section.

Occurrence. — Melajo River area: EL 1810, Hutch 47, Hutch 51, KR 11862, K 9797, K 9903, RR 290, RR 293, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 1429, K 8399, K 12255, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 10432a, USGS 20433, USGS 20434, USGS 21778. Matura Bay: JS 67, RR 230, PJ 302, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Trigoniocardia (Trigoniocardia) melajoensis n. sp. Pl. 25, figs. 11, 12

Shell small, subrhomboidal. Posterior umbonal angulation pro-

nounced. Sculpture consists of 18-20 ribs. Posterior slope mostly with seven low, flat ribs sometimes carrying beads; their interspaces narrow. Central part of shell disc covered by three or four much stronger, elevated ribs with interspaces which are narrow at the bottom and crossed by concentric threads. Their cross section is triangular, and their crest is usually ornamented with beads. The anterior ones of these ribs become asymmetrically triangular in cross section with the steeper slope posteriorly. Toward the anterior slope the ribs become lower and flatter carrying transverse beads. Hinge normal. Inner margin strongly fluted.

Holotype. — USNM 645354.

Dimensions of holotype (left valve). — Length 10.0 mm, height 10.6 mm.

Type locality. — Melajo River area: USGS 18411.

This species occurs at the base of the Melajo Clay but is rare. It is more abundant in the Savaneta Glauconitic Sandstone Member of the Springvale Formation, where it is represented from the following USGS localities: 19883, 20428, 20429 (all Savaneta River), and 21809 (Springvale Quarry).

T. heredium (Olsson) (1922, p. 227, pl. 27, fig. 10) from the middle Miocene Gatun Formation of Costa Rica is more oval in outline, less produced postero-ventrally. The discrepancy in size of the ribs is less marked. *T. thaumastum* (Woodring) (1925, p. 144, pl. 19, figs. 12, 13) from Bowden, Jamaica, is considerably higher than long. Its ribs have a different cross section, their discrepancy in prominence is less conspicuous, and the posterior umbonal angulation sharper than in *T. melajoensis*.

T. deadenensis (Mansfield) (1932a, p. 113, pl. 22, figs. 2-5) from the middle and upper Miocene of Florida has a heavier hinge, less marked dissimilarity of the ribs. *T. caboblanquensis* Weisbord (1964, p. 256, pl. 35, figs. 10-12, pl. 36, figs. 2-6), from the Pliocene Mare Formation of Venezuela, essentially differs by its less pronounced posterior umbonal angulation.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm.

Trigoniocardia (Trigoniocardia) cf. caboblanquensis Weisbord

Pl. 25, figs. 15, 16

A single right valve from the Courbaril beds is at hand. It is worn, so that no nodes are preserved on the ribs. Outline sub-rhomboidal, about as long as high. Sculpture consists of 19 ribs. Seven low and closely set ribs on the posterior slope. In front of the posterior umbonal ridge there are four strong, widely spaced ribs. Anterior ribs low again. Central and anterior ribs with transverse beads, if not worn. All the interspaces crossed by threads. Hinge with two cardinals. Anterior lateral tooth much nearer to the cardinals than posterior lateral. Inner surface coarsely fluted.

T. caboblanquensis Weisbord (1964, p. 256, pl. 35, figs. 10-12, pl. 36, figs. 2-6) from the lower Pliocene Mare Formation of the Cabo Blanco area, Venezuela, has the same dimensions, proportions, and number of ribs. The single valve from Point Courbaril, however, does not allow a positive determination.

A single, immature specimen from Matura (USGS 19860) identified as *Trigoniocardia* (*Trigoniocardia*) spec. may represent the same form as the Courbaril shell.

There has been some confusion as to the identity of the Recent *T. antillarum* (d'Orbigny) (1842, pl. 27, figs. 53-55; 1845, p. 338) and *T. ceramida* (Dall) (1886, p. 269, pl. 4, fig. 6). Dall (1901, p. 387) put *T. ceramida* in the synonymy of *T. antillarum*. As pointed out by Abbott (1958, p. 125) *T. antillarum* of Clench and Smith (1944, p. 19, pl. 11, figs. 3, 4) is *T. guppyi* (Thiele) (1910, p. 129, pl. 9, figs. 25, 26) from Barbados, of which many topotypes are at hand. Apparently D'Orbigny's original figure of *T. antillarum* was misleading for the later interpretations of that species (see also McLean, 1951, p. 72, pl. 14, fig. 4). But in the original description, although not satisfactory, D'Orbigny clearly stated: ". . . radiatim inaequaliter 21-costata. . . , costis. . . medio latis. . ." and ". . . fácil de distinguir por sus costillas desiguales. . ." These features are certainly not applicable to *T. guppyi* originally described as having 27 ribs, although the number of ribs is somewhat variable in *T. antillarum* as well as in *T. guppyi*. Thus Abbott's interpretation (1958, pp. 123, 124) of the three taxa mentioned above is adopted here.

The shell from the Courbaril beds is strikingly similar to the specimen described from the middle Miocene of Venezuela (Jung, 1965, p. 453, pl. 57, figs. 3, 6) as *T. aff. ceramida* (Dall). The latter

is somewhat larger, and its ribs just in front of the posterior umbonal ridge are narrower, and have a different cross section.

The Recent *T. granifera* (Broderip and G. B. Sowerby I) (see Olsson, 1961, p. 251, pl. 38, fig. 3) from the Pacific Coast of America has much wider interspaces and narrower ribs centrally. Also there are more ribs on its posterior slope.

Occurrence.—RR 120.

Subgenus **AMERICARDIA** Stewart

Stewart, 1930, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 3, p. 267.

Type species (by original designation), *Cardium medium* Linné.

Trigoniocardia (Americardia) perimaris (Maury)

1925. *Cardium (Trigoniocardia) perii-maris* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 136, pl. 23, fig. 8.

Shell small, subquadrate. Umbones high. Posterior carina prominent. In front and behind the carina there are radial depressions. There are 15 ribs in front of the carina and nine behind it. Ribs on central part of shell broad, their interspaces narrow and crossed by fine concentric threads. Inner margin fluted.

Holotype.—Paleont. Research Inst., Ithaca, N. Y., No. 928.

Dimensions of holotype.—Length 10.8 mm, height 11.0 mm, convexity 5.2 mm.

Type locality.—Matura, Trinidad.

This species is not represented in the material under study. It is known from the holotype only which is somewhat worn and damaged.

T. perimaris closely resembles the middle Miocene *T. stewarti* Olsson (1964, p. 56, pl. 8, fig. 9) from Ecuador. *T. stewarti* has 12 broad radials in front of the postero-umbonal ridge instead of 15, which carry transversely elongated nodes anteriorly and near the umbo. The Ecuadorian *T. stewarti* needs a new name as the name is preoccupied by *T. (Americardia) stewarti* (Olsson) (1932, p. 101, pl. 8, fig. 8) from Peru.

Occurrence.—Matura, Trinidad.

Distribution.—Known from type locality only.

Genus **LAEVICARDIUM** Swainson

Swainson, 1840, Treatise on Malacology, p. 373.

Type species (by subsequent designation, Bucquoy, Dautzenberg, and Dollfus, 1892, *Mollusques marins du Roussillon*, vol. 2, p. 298), *Cardium europaeum* Wood (= *Cardium norvegicum* Spengler).

Laevicardium cf. **laevigatum** (Linné)

This form is represented by two specimens from the Courbaril beds. They are filled with matrix and not complete.

Clench and Smith (1944, pp. 22-23) showed that *laevigatum* is the correct name for the widely distributed Western Atlantic species which had been known formerly as *serratum*. *L. laevigatum* ranges in time from Miocene to Recent.

Occurrence.—USGS 20432a.

Family **VENERIDAE**Genus **DOSINIA** Scopoli

Scopoli, 1777, *Introductio ad historiam naturalem*, . . . p. 399.

Type species (by monotypy and tautonymy), *Chama dosin* Adanson (= *Venus concentrica* Born).

Subgenus **DOSINIA** s. str.

According to Fischer-Piette (1942, pp. 308-314) *Chama dosin* Adanson is the same as *Venus concentrica* Born. As the latter is the type species (by original designation) of the subgenus *Dosinidia* Dall (1902a, p. 347), *Dosinidia* becomes an objective synonym of *Dosinia* s. str.

Dosinia (**Dosinia**) **grandis** Nelson

- 1870. *Dosinia grandis* Nelson, Connecticut Acad. Sci., Trans., vol. 2, p. 201.
- 1910. *Dosinia liogona* Dall, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, pp. 6, 12; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 149, 154. Not of Dall, 1903.
- 1922. *Dosinia* (*Dosinidia*) *grandis* Nelson, Spieker, Johns Hopkins Univ. Stud. Geol., No. 3, p. 138, pl. 8, fig. 4: same specimen as lectotype selected by Palmer.
- 1925. *Dosinia* (*Dosinidia*) *titan* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 139, pl. 24, figs. 1, 2, pl. 25, fig. 3.
- 1927. *Dosinia* (*Dosinidia*) *grandis* Nelson, Palmer, Palaeont. Amer., vol. 1, No. 5, p. 67, 1929, *ibidem*, pl. 17, fig. 12 (lectotype), pl. 19, fig. 8, pl. 20, fig. 14, pl. 45, figs. 1-4.
- 1932. *Dosinia* (*Dosinidia*) *grandis* Nelson, Olsson, Bull. Amer. Paleont., vol. 19, No. 68, p. 105.

1941. *Dosinia* (*Dosinidia*) *grandis* Nelson, Pilsbry and Olsson, Acad. Nat. Sci. Philadelphia, Proc., vol. 93, p. 60.
1942. *Dosinia* (*Dosinidia*) *grandis* Nelson, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 116, pl. 5, figs. 1-3.

This species is represented from the base of the Melajo Clay by a few incomplete valves. They are the same as topotypes of *D. titan* from Springvale Quarry. Rutsch (1942, p. 117) gave some remarks on the variability of *D. grandis*.

D. grandis is more inflated than the Recent Caribbean species of *Dosinia* (Clench, 1942, pp. 1-5) and the species from the Cabo Blanco area (Venezuela) described as *D. concentrica prosapia* by Weisbord (1964, p. 268). According to Olsson (1961, p. 260) *D. grandis* is the same as the Recent West Coast *D. ponderosa* (Gray), a species ranging from late Miocene to Recent.

Occurrence. — RR 291, USGS 18411, USGS 18634.

Distribution. — See Olsson (1961, pp. 260-261).

***Dosinia* (*Dosinia*) species**

There is a species of *Dosinia* represented by a few valves and some fragments from the Melajo Clay and the Courbaril beds. It clearly differs from *D. grandis* by its finer sculpture. The concentrics of early stages of *D. grandis* from Springvale and the base of the Melajo Clay are considerably coarser.

The width of the concentrics of the material at hand corresponds best with that of the Recent *D. discus* (Reeve), but this species is less inflated. According to Clench (1942, p. 5) the range of *D. discus* is from Virginia to Yucatan, but records from the Gulf coast of Mexico and Central America are rare. The present material seems to belong to the vicinity of the Recent *D. concentrica* (Born) which ranges from Cuba and Panama throughout the West Indies to Brasil.

Occurrence. — Melajo River area: Hutch 51, KR 11862, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, PJ 212, USGS 10991, USGS 20432a, USGS 20433, USGS 20434.

Genus CYCLINELLA Dall

Dall, 1902, Nautilus, vol. 16, No. 4, p. 44.

Type species (by subsequent designation, Dall, 1902, U. S. Nat. Mus., Proc., vol. 26, p. 357), *Dosinia* (*Artemis*) *tenuis* Recluz.

Cyclinella aff. tenuis (Recluz)

Pl. 26, figs. 1, 2

Only one right valve from the Courbaril beds is at hand. It differs from the Recent *C. tenuis* (Recluz) (1852, p. 250, pl. 10, figs. 1, 1') from Guadeloupe in being more inflated and in having coarser concentrics. Its lunular area is more concave, and its posterior, bifid cardinal is more oblique and narrower.

Occurrence. — USGS 20432a.

Cyclinella (?) species

A species probably belonging to *Cyclinella* is represented from the Melajo Clay by a single fragment. Its hinge is concealed by matrix. No specific affinities can be recognised.

Occurrence. — USGS 21178.

Genus TIVELA Link

Link, 1807, Beschreibung der Naturalien-Sammlung der Universität zu Rostock. 3. Abtheilung, p. 152.

Type species (by subsequent designation, Dall, 1902, U. S. Nat. Mus., Proc., vol. 26, No. 1312, p. 349), *Venus corbicula* Gmelin (= *Venus mactroides* Born).

Subgenus TIVELA s. str.**Tivela (Tivela) austeniana** (Maury) Pl. 25, figs. 13, 14; Pl. 26 figs. 3-6

1864. *Trigona mactroides* Chemnitz, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 36; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 16.
1867. *Trigona mactroides* Born, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.
1912. *Mactra austeniana* Maury, Acad. Nat. Sci. Philadelphia, Jour. ser. 2, vol. 15, p. 61, pl. 9, figs. 22, 23.
1925. *Tivela austeniana* Maury, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 144, pl. 27, fig. 2.
1925. *Tivela austeniana maturensis* Maury, *ibidem*, p. 144, pl. 27, fig. 1.
1927. *Tivela nasuta austeniana* (Maury), Palmer, Palaeont. Amer., vol. 1, No. 5, p. 109, 1929, pl. 22, figs. 5, 12.
1927. *Tivela nasuta maturensis* Maury, Palmer, *ibidem*, p. 109; 1929, pl. 22, fig. 5a.

Shell of medium size, equilateral to slightly inequilateral, little longer than high. Umbones inflated. Dorsal margins straight. Anterior and posterior ends evenly curved. Sculpture consists of incrementals only. Hinge with two pairs of cardinal teeth. Left anterior lateral tooth strong, right one less so. Ligamental area sunken, well defined. Pallial sinus not deep.

Lectotype (of austeniana). — Cornell Univ., Paleont. Museum, Ithaca, N. Y., unnumbered.

Dimensions of lectotype (of austeniana). — Length 27.0 mm, height 21.3 mm.

Type locality (of austeniana). — Along shore, 1000 feet west of Brighton pier, near Pitch Lake, Trinidad.

Holotype (of austeniana maturensis). — Paleont. Res. Inst., Ithaca, N. Y., No. 951.

Type locality (of austeniana maturensis). — Matura, Trinidad.

The type locality of *T. austeniana* belongs to the Upper Morne l'Enfer Formation. The lectotype of *T. austeniana* is here selected and figured (Pl. 25, figs. 13, 14). Brighton specimens are said to be longer than Matura shells. This is true but not a rule: the proportions of the Matura shells are not constant.

Guppy identified the material from Matura as *T. mactroides* (Born) (see also Weisbord, 1964, p. 276). The differences of the two species are slight indeed. The Recent species usually reaches a much larger size. Comparing series of equally sized specimens of both forms shows that the Matura shells have somewhat more accentuated umbonal ridges on an average, and that the pallial sinus is deeper in *T. mactroides*.

The Recent *T. nasuta* Dall (1902a, p. 380, pl. 12, fig. 2) from Santa Marta, Colombia, has a well-defined lunule which is not the case in *T. austeniana*.

Occurrence. — K 10924, JS 67, RR 230, USGS 18204, USGS 19860.

Distribution. — Upper Morne l'Enfer Fm. and Matura shell bed, Trinidad.

Genus **MACROCALLISTA** Meek

Meek, 1876, Rept. U. S. Geol. Survey of the Territories, vol. 9, p. 179.

Type species (by monotypy), *Venus gigantea* Gmelin (= *Venus nimbose* (Lightfoot)).

Macrocallista maculata (Linné)

1758. *Venus maculata* Linné, Systema Naturae, ed. 10, p. 686.

1964. *Macrocallista maculata* (Linnaeus), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 286, pl. 41, figs. 11-15, pl. 42, figs. 1-6. For further citations see this publication.

1965. *Macrocallista maculata* (Linné), Jung, Bull. Amer. Paleont., vol. 49, No. 223, p. 469, pl. 58, figs. 4-6.

This species is well represented from the base of the Melajo Clay.

Occurrence. — RR 291, USGS 18411, USGS 18634.

Distribution. — Miocene to Recent. For details see Weisbord (1964, p. 291).

Genus **PITAR** Römer

Römer, 1857, Kritische Untersuchung der Arten des Molluskengeschlechts *Venus* bei Linné und Gmelin, p. 15.

Type species (by monotypy), *Venus tumens* Gmelin.

Subgenus **LAMELLICONCHA** Dall

Dall, 1902, U. S. Nat. Mus., Proc., vol. 26, No. 1312, p. 354.

Type species (by original designation), *Cytherea concinna* G. B. Sowerby I.

- Pitar (Lamelliconcha) circinatus** (Born) Pl. 26, figs. 7-13; Pl. 27, figs. 1, 2
 1780. *Venus circinata* Born, Testacea Musei Caesaris Vindobonensis, p. 61, pl. 4, fig. 8.
 1867. *Cytherea circinata* Born, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.
 1874. *Cytherea circinata* Born, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442.
 1925. *Pitaria (Lamelliconcha) circinata* Born, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 149, pl. 27, figs. 12, 13.
 1927. *Pitaria (Lamelliconcha) circinata* (Born), Palmer, Palaeont. Amer., vol. 1, No. 5, p. 48. 1929, pl. 9, figs. 10, 11, 12, 15, 16, 19. For further citations see this publication.
 1931. *Pitaria (Lamelliconcha) circinata* (Born), Hodson and Hodson, Bull. Amer. Paleont., vol. 16, No. 59, p. 10, pl. 4, figs. 5, 7.
 1951. *Pitar (Hysteroconcha) circinata* (Born), McLean, New York Acad. Sci., Sci. Sur., Porto Rico Virgin Islands, vol. 17, pt. 1, p. 81, pl. 16, fig. 8.
 1960. *Pitaria (Lamelliconcha) circinata* Born, Barrios, Bol. Geol., vol. 6, Nos. 1-3, Informe No. 1082, p. 252, pl. 5, fig. 11.
 1961. *Pitar circinata* (Born), Warmke and Abbott, Caribbean Seashells, p. 189, pl. 39 j.
 1965. *Pitar (Lamelliconcha) circinatus* (Born), Jung, Bull. Amer. Paleont., vol. 49, No. 223, p. 463, pl. 59, figs. 1-3.

Syntypes. — Vienna Natural History Museum, Nos. 76522, 76523, 76524.

This species is well represented from Matura, the Courbaril beds, and the Melajo Clay. Matura representatives of *P. circinatus* have been considered as dwarfed by Maury. Specimens at hand, however, reach a length of 29 mm and a height of 25 mm.

Specimens from the Melajo Clay are somewhat more elongate. They are well preserved having highly elevated concentric lamellae

which may alternate in size. These slight differences from typical *P. circinatus* fall within the variability as the same features are shown by Recent specimens.

For a discussion of the relations of *P. circinatus* and *P. alternatus* (Broderip) see Olsson (1961, p. 286).

Occurrence.—Melajo River area: EL 1810, Hutch 47, Hutch 51, KR 11862, K 9797, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, K 8399, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778. Matura Bay: RR 230, USGS 18204, USGS 19860.

Distribution.—Miocene to Recent (see Palmer, 1927-1929, p. 50, 1927).

Pitar (Lamelliconcha) labreanus (Maury)

Pl. 27, figs. 3-6

1912. *Pitaria (Lamelliconcha) labreana* Maury, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 15, p. 57, pl. 9, figs. 14, 15.

1925. *Pitaria (Lamelliconcha) labreana* Maury, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 151, pl. 27, fig. 11.

1927. *Pitaria (Lamelliconcha) labreana* Maury, Palmer, Palaeont. Amer., vol. 1, No. 5, p. 51. 1929, pl. 8, figs 19, 28.

Shell of medium size, elongate, inequilateral. Anterior end produced, posterior end somewhat pointed. There is a shallow, radial depression in front of the posterior umbonal ridge. Sculpture consists of numerous, rounded concentrics with wider interspaces. Lunule well defined. Right hinge with three cardinals and a deep socket for the left anterior lateral. Right anterior and posterior cardinals connected. Left hinge with three cardinals, the anterior and middle ones connected dorsally. Pallial sinus deep.

Holotype.—Cornell Univ., Paleont. Museum, Ithaca, N. Y., unnumbered.

Dimensions of holotype (left valve).—Length 17.3 mm, height 13.5 mm.

Type locality.—A thousand feet west of Brighton pier, near Pitch Lake, Trinidad.

This species is represented from the Melajo Clay. Melajo specimens grow larger than the holotype which does not seem to be adult. The material under study does not contain specimens from the type area.

P. labreanus is most closely related to the Recent Pacific Coast *P. paytensis* (d'Orbigny) (see Olsson, 1961, p. 288, pl. 48, figs. 6-6b)

and *P. concinnus* (G. B. Sowerby I) (1835, p. 23; Olsson, 1961, p. 287, pl. 48, figs. 4-4c). The former is more elongate, the latter shorter than *P. labreanus*, but they all have the same kind of sculpture and the radial depression in front of the posterior umbonal ridge.

P. salanga Pilsbry and Olsson (1941, p. 61, pl. 15, figs. 10, 11) from the Pliocene of Ecuador is a larger species and proportionately higher. *P. labreanus* has also been compared with the larger *P. hilli* Dall [1890-1903 (1903), p. 1268, pl. 54, fig. 7] from the middle Miocene Gatun Fm. of the Panama Canal Zone.

Occurrence.—Hutch 51, USGS 18399, USGS 21178.

Distribution.—Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm.

Genus **CHIONE** Megerle von Mühlfeld

Megerle von Mühlfeld, 1811, Mag. Ges. Naturf. Freunde zu Berlin, vol. 5, p. 51.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 183), *Venus dysera* Chemnitz (= *Venus cancellata* Linné).

Subgenus **CHIONE** s. str.

Chione (Chione) cancellata (Linné) Pl. 27, fig. 7; Pl. 28, figs. 1, 2

1767. *Venus cancellata* Linné, Systema Naturae, ed. 12, p. 1130.
 1864. *Venus cingenda* Dillwyn, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 36; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 16.
 1867. *Venus cancellata* Gronov., Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.
 1874. *Venus cancellata* Gron., Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 442.
 1925. *Chione (Chione) cancellata* Linnaeus, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 153, pl. 28, figs. 1, 5.
 1964. *Chione (Chione) cancellata* (Linnaeus), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 306, pl. 44, figs. 1-8. For additional citations see this publication.

This species is abundant at Matura, but most specimens are worn. Large valves have a length of more than 30 mm. Three small valves from the Melajo Clay seem to belong to this species.

Occurrence.—Melajo River area: KR 11862 (?), USGS 18399 (?). Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution.—Miocene to Recent. For details see Weisbord (1964, p. 311).

Subgenus **NIOCHE** Hertlein and Strong

Hertlein and Strong, 1948, *Zoologica*, New York Zool. Soc., vol. 33, pt. 4, No. 13, p. 186.

Type species (by original designation), *Venus asperrima* G. B. Sowerby I.

Chione (Nioche) veatchiana Maury

Pl. 28, figs. 3-11

1912. *Chione veatchiana* Maury, *Acad. Nat. Sci. Philadelphia, Jour.*, ser. 2, vol. 15, p. 58, pl. 9, figs. 17, 18.
1912. *Chione dalliana* Maury, *ibidem*, p. 59, pl. 9, fig. 16.
1912. *Chione guppyana* Maury, *ibidem*, p. 59, pl. 9, fig. 19. Not of Gabb, 1873.
1925. *Chione (Chione) dalliana* Maury, Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 156, pl. 28, fig. 10.
1925. *Chione dalliana veatchiana* Maury, Maury, *ibidem*, p. 157, pl. 28, fig. 14.
1925. *Chione dalliana guppyana* Maury, Maury, *ibidem*, p. 158, pl. 28, figs. 4, 13.
1927. *Chione (Chione) dalliana* Maury, Palmer, *Palacont. Amer.*, vol. 1, No. 5, p. 154, pl. 40, figs. 2, 7, 14, 15, 23.

Shell of small to medium size, subcircular to elongate-triangular. Sculpture consists of rounded, radial riblets, and concentric lamellae. Radials simple in young stages, double later, and triple toward the ventral margin. Concentrics scalloped. Anteriormost four to seven ribs much larger than the rest. Lunule large, mainly radially sculptured, bordered by an incised line. Escutcheon larger in left valve. Hinge with three cardinals in each valve. Right anterior cardinal lamellar, subparallel to lunular margin. Right central cardinal prolonged along base of hinge plate. Right posterior cardinal slightly bifid. Left anterior cardinal elongate, broader anteriorly; middle one stout, bifid; posterior one narrow, elongate. Inner margin with fine crenulations.

Lectotype of veatchiana (right valve).—Paleont. Museum, Cornell Univ., Ithaca, N. Y., No. 33504.

Dimensions of lectotype of veatchiana.—Length 25.1 mm, height 20.2 mm.

Type locality of veatchiana.—A thousand feet west of Brighton pier, near Pitch Lake, Trinidad.

Lectotype of dalliana (right valve).—Paleont. Museum, Cornell Univ., Ithaca, N. Y., No. 33495.

Dimensions of lectotype of dalliana.—Length 20.5 mm, height 18.0 mm.

Type locality of dalliana.—A thousand feet west of Brighton pier, near Pitch Lake, Trinidad.

Lectotype of guppyana (right valve). — Paleont. Museum, Cornell Univ., Ithaca, N. Y., unnumbered.

Dimensions of lectotype of guppyana. — Length 19.1 mm., height 17.2 mm.

Type locality of guppyana. — Along shore, 700 feet east of Brighton pier, near Pitch Lake, Trinidad.

As pointed out by Palmer (1927-1929, p. 155, 1927) the three forms described by Maury as *C. veatchiana*, *C. dalliana*, and *C. guppyana* should be treated as one species. The variability of the outline is considerable. *C. veatchiana* was meant to include elongate shells. But elongate shells occur together with shorter ones not only at the type locality of *C. veatchiana*, but also at the type locality of *C. guppyana*, and at Matura. For this variable species the name *veatchiana* should be used as it has page priority.

Maury compared *C. veatchiana* with *C. walli* (Guppy) (1866b, p. 581, pl. 26, fig. 16) from the middle Miocene Manzanilla Formation of Manzanilla Bay, Trinidad. *C. walli*, however, is a different species with a different hinge belonging to *Chionopsis*.

C. veatchiana is most closely related to the Recent *C. subrostrata* (Lamarck) (Animaux sans vertèbres, vol. 5, p. 588, 1818). Perhaps they should be treated as one species. On an average *C. subrostrata* may have a somewhat heavier shell and coarser sculpture. But these differences are slight. According to Weisbord (1964, p. 323) *C. subrostrata* probably occurs in the Pliocene of Venezuela as well.

Nioche marcottae Olsson and Petit (1964, p. 532, pl. 77, figs. 6, 6a) from the Pliocene of St. Petersburg, Florida, seems to differ from *C. veatchiana* by its more prominent concentric lamellae. In both species the escutcheon is not restricted to the left valve, although it is smaller in the right valve. *C. veatchiana* has the same hinge as the Recent Pacific Coast *Nioche beili* Olsson (1961, p. 310, pl. 50, figs. 1, 1a, 1b, 4), the type species of Olsson's subgenus *Antinioche*, but is smaller. *N. beili* has only simple radials.

Occurrence. — Point Courbaril: K 1429, K 8399, K 12255, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 20433, USGS 20434. Matura Bay: K 10924, JS 67, RR 230, PJ 302, USGS 18204. USGS 19860.

Distribution.—Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed, and Pleistocene of southern Trinidad.

Subgenus **LIROPHORA** Conrad

Conrad, 1863, Acad. Nat. Sci. Philadelphia for 1862, Proc., pp. 575, 586.

Type species (by subsequent designation, Dall, 1902, U. S. Nat. Mus., Proc., vol. 26, No. 1312, p. 358), *Circomphalus athleta* Conrad (= *Venus latilirata* Conrad).

Chione (Lirophora) caroniana Maury

Pl. 29, figs. 1-8

1910. *Venus glyptocyma* (Dall), Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 11; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 153. Not of Dall, 1903.
1925. *Chione (Lirophora) caroniana* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 163, pl. 29, figs. 5, 7, 8.
1927. *Chione (Lirophora) caroniana* Maury, Palmer, Palaeont. Amer., vol. 1, No. 5, p. 173. 1929, pl. 44, fig 18.
1938. *Chione (Lirophora) caroniana* Maury, Vokes, Amer. Museum Novitates, No. 988, p. 3.
1942. *Chione (Lirophora) caroniana* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 102.
1942. *Chione (Lirophora)* sp. ind., Rutsch, *ibidem*, p. 102.

Shell of medium size, elongate-trigonal, heavy. Umbones situated slightly anteriorly. Antero-dorsal margin concave. Anterior end produced, strongly arched. Postero-ventrally straightened. Posterior end somewhat pointed. Postero-dorsal margin straight. Sculpture of young stages generally consists of some inflated concentrics. Later the concentrics are irregularly fused and form broad, flattish bands. At the anterior and posterior ends of these bands there are a few raised lamellae indicating the number and position of the "original" concentrics. Toward the ventral margin there are some narrower concentrics again. Lunule and escutcheon large, sculptured by growth lines. Hinge of both valves with three cardinals. Right anterior cardinal small and thin, middle one triangular and slightly extended along base of hinge plate, posterior one long and narrow. Left anterior cardinal elongate, somewhat thicker anteriorly, central one triangular, posterior one long and thin. Inner margin with fine crenulations. Pallial sinus small, but pointed.

Holotype.—Paleont. Research Inst., Ithaca, N. Y., No. 978.

Type locality.—Springvale Quarry, Trinidad.

C. caroniana is most abundant in the Savaneta Glauconitic

Sandstone Member of the Springvale Formation. From the Melajo Clay it is represented by about 100 specimens of all growth stages.

Specimens from a single locality show an extraordinary variability concerning width and number of concentrics. Broad concentrics and coalescence of concentrics are prevailing in the material from the base of the Melajo Clay, where the matrix is coarse-grained, but rare and never extreme in the overlying silty clay. Thus it looks as if the ornamentation were facies controlled.

Although it is unsatisfactory comparisons are omitted here, because a considerable number of species showing features similar to those of *C. caroniana* have been described from northern South America, Central America, and the southeastern United States. But it would require a special study to show their mutual relationships.

Occurrence. — EL 1810, Hutch 51, K 9797, K 9816, K 9903, RR 290, RR 291, PJ 285, USGS 18399, USGS 18411, USGS 18634, USGS 21178.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm.

Chione (Lirophora) species

Pl. 30, figs. 1-3

1925. *Chione (Lirophora) latilirata* Conrad, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 161, pl. 29, figs. 1, 2, 9.

1925. *Chione (Lirophora) riomaturensis* Maury, *ibidem*, p. 162, pl. 29, fig. 4.

1927. *Chione (Lirophora) riomaturensis* Maury, Palmer, Palaeont. Amer., vol. 1, No. 5, p. 181. 1929, pl. 44, fig. 2.

C. riomaturensis is based on an inadequate sample. Fully grown specimens are not known. Maury considered *C. riomaturensis* intermediate in characters between the Miocene to Recent *C. latilirata* (Conrad) (1841, p. 28) and the Recent *C. paphia* (Linné) (Systema Naturae, ed. 12, p. 1129, 1767). It cannot be decided whether the Matura species belongs to *C. latilirata* or *C. paphia* as immature specimens of the latter two species are practically indistinguishable. The large collections in the U. S. National Museum of these two species show that the concentrics of immature *C. latilirata* may thin out just like those of *C. paphia*.

Weisbord (1964, p. 323, pl. 45, figs. 15, 16, pl. 47, figs. 1-6) recorded *C. riomaturensis* from the Pliocene Mare Formation of Venezuela. Specimens from the Cabo Blanco area at hand suggest that they are closer to *C. latilirata*. *C. cultellata* Weisbord (1964, p.

326, pl. 47, figs. 7-12), also from the Mare Formation of Venezuela, is based on a few immature valves.

Occurrence.—JS 67, RR 230, USGS 19860.

Chione (Lirophora) sanctidavidis Maury

Pl. 30, figs. 4-9

1925. *Chione* (*Clausinella* ?) *sancti-davidis* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 161, pl. 28, fig. 12.

1927. *Chione* (*Chione*) *sancti-davidis* Maury, Palmer, Palaeont. Amer., vol. 1, No. 5, p. 160. 1929, pl. 44, fig. 10.

Shell of small to medium size, inequilateral, moderately inflated. Antero-dorsal margin straight to slightly concave. Anterior end strongly rounded. Posterior end produced. Postero-dorsal margin almost straight. Sculpture of early stages consists of raised concentric lamellae and later of rounded concentrics which sometimes are bent upwards. Their interspaces usually broader. Ventral side of concentrics with fine radial striae crossing the interspaces. The concentrics may become lamellar anteriorly and posteriorly. Lunule and escutcheon well defined, sculptured by growth lines. Hinge of both valves with three cardinals. Right anterior cardinal small, lamellar, middle one trigonal and slightly extended along base of hinge plate, posterior one long. Left anterior cardinal elongate, slightly curved and thicker anteriorly, central one trigonal, posterior one long. Ventral and lunular margins finely crenulated. Pallial sinus short, but sharply pointed.

Holotype.—Paleont. Research Inst., Ithaca, N. Y., No. 972.

Type locality.—Matura, Trinidad.

This species is rare at its type locality. The holotype is an immature, worn, right valve. This situation is unfortunate, because this species is represented by numerous perfect specimens from the Courbaril beds as well as from the Melajo River area. The valves from Matura are less inflated than those from Point Courbaril, and those from the Melajo Clay are shorter on an average. The sculpture of *C. sanctidavidis* is variable. Usually the concentrics are regularly spaced, but irregularities as to spacing and thickness of the concentrics are not rare. The lamellar concentrics at the margins of lunule and escutcheon are not a rule but may be present.

It does not seem advisable to separate the Courbaril and Melajo specimens from those from Matura specifically or subspecifically. There is an unnamed species occurring in the Gransauil beds of

the lower Springvale Formation which may have to be separated. That species is larger than *C. sanctidavidis*, and its concentrics are more closely set. *C. ebergenyii* (Böse) (1906, p. 28, pl. 2, figs. 4-17) from beds of questionable Pliocene age of Mexico has more numerous concentrics and a marked posterior umbonal ridge.

Occurrence. — Melajo River area: K 9813. Point Courbaril: K 1429, K 8839, K 12013, K 12255, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 20433, USGS 20434, USGS 21778. Matura Bay: RR 230.

Distribution. — Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Genus **ANOMALOCARDIA** Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, p. 134.

Type species (by monotypy), *Anomalocardia rugosa* Schumacher (= *Venus flexuosa* Linné).

Anomalocardia brasiliiana (Gmelin)

Pl. 30, figs. 10, 11

1791. *Venus brasiliiana* Gmelin, Systema Naturae, ed. 13, p. 3289.

1864. *Venus macrodon* Deshayes, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 36; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 16.

1867. *Venus flexuosa* Linné, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.

1925. *Anomalocardia brasiliiana* Gmelin, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 165, pl. 29, figs. 10, 11.

1964. *Anomalocardia brasiliiana* (Gmelin), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 272, pl. 38, figs. 5-8. For further citations see this publication.

This species is rare at Matura. The figured specimen is worn and does not show much of the external sculpture. It is smaller and not as heavy as Recent specimens from Brasil at hand.

Occurrence. — JS 67, PJ 302, USGS 18204, USGS 19860.

Distribution. — Upper Miocene (?) to Recent. For details see Weisbord (1964, p. 274).

Family **MACTRIDAE**

Genus **MACTRA** Linné

Linné, 1767, Systema Naturae, ed. 12, p. 1125.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 185), *Cardium stultorum* Linné.

Subgenus **MICROMACTRA** Dall

Dall, 1894, *Nautilus*, vol. 8, No. 4, p. 40.

Type species (by monotypy), *Mactra californica* Conrad.

Mactra (Micromactra) cf. maracaibensis H. K. Hodson Pl. 30, figs. 12, 13;
Pl. 31, figs. 1, 2

This form is represented from Matura and the Melajo Clay by a few specimens including only one complete shell. It might belong to *M. maracaibensis* H. K. Hodson (*in* Hodson and Hodson, 1931a, p. 20, pl. 9, figs. 6, 19) which had been described from the Miocene of Venezuela. Apparently the Trinidad specimens are immature looking exactly like the material described from the middle Miocene of the Paraguaná Peninsula, Venezuela (Jung, 1965, p. 468, pl. 60, figs. 3, 5). Adult specimens of *M. maracaibensis* from Venezuela have a similar outline as *M. macescens* (Guppy) (1866b, p. 581, pl. 26, fig. 2) from the middle Miocene Manzanilla Formation of Trinidad but are less produced anteriorly, *i.e.* their umbones are almost central and not behind the middle of the shell. Their posterior ridge is less pronounced, and the concentric waves are restricted to the dorsal part of the shell. *M. aff. macescens* from the Springvale Formation (Rutsch, 1942, p. 119) may be the same as the Melajo and Matura specimens.

The type specimen of *M. undula* Dall [1890-1903 (1898), p. 893, pl. 28, fig. 12] from the Pliocene of South Carolina reaches twice the size of the complete specimen from Matura. Additional specimens of *M. undula* in the collections of the U. S. National Museum from Shell Creek (USNM 153745) and the Caloosahatchee River (USNM 153743) have comparable dimensions. *M. undula* constantly differs from the Trinidad material by its less pronounced undulations on the umbo.

Occurrence. — Melajo River area: EL 1810. Matura Bay: RR 230, USGS 18204.

Genus **MULINIA** Gray

Gray, 1837, *Mag. Nat. History*, new ser., vol. 1, p. 375 (not seen).

Type species (by subsequent designation, Herrmannsen, 1847, *Indicis generum malacozoorum*, vol. 2, p. 61), *Mactra lateralis* Say.

Mulinia species Pl. 31, figs. 3-5

Shell of medium size, almost equilateral, broadly trigonal in

young stages, highly trigonal in adult stage. Anterior end broadly rounded, posterior end somewhat pointed. Umbones moderately inflated. Posterior umbonal ridge well defined, angular. Anterior umbonal ridge rounded. Ligament entirely internal.

The characteristic feature of the genus *Mulinia* is its internal ligament. The chondrophoral pit is deep and covered by a thin roof. On worn specimens, like those from Matura, this roof is broken, and the chondrophoral pit may then reach up to the beaks.

The Matura specimens seem to differ from the Recent *M. cleryana* (d'Orbigny) (see Weisbord, 1964, p. 382, pl. 55, figs. 3-6) only by their less pronounced inflation of the umbones. *M. lateralis* (Say) (1822, p. 309) as figured by Abbott (1954, pl. 32o) has lower umbones than the Trinidad material. The Recent Pacific Coast *M. pallida* (Broderip and G. B. Sowerby I) (see Olsson, 1961, p. 330, pl. 58, figs. 2-2c) is of similar shape but much larger. It has also been recorded from the late Miocene to lower Pliocene Borbon Formation of Ecuador (Olsson, 1964, p. 64).

Occurrence. — Point Courbaril: K 1429, K 12013, PJ 212, USGS 10432, USGS 20434 (immature specimens). Matura Bay: RR 230, PJ 302, USGS 18204, USGS 19860.

Family **TELLINIDAE**

Genus **MOERELLA** Fischer

Fischer, 1887, Manuel de Conchyliologie, p. 1147.

Type species (by monotypy), *Tellina donacina* Linné.

Subgenus **MOERELLA** s. str.

Moerella (Moerella) elinguis, n. sp.

Pl. 31, figs. 6-9

Shell small, elongate, strongly inequilateral. Dorsal margins somewhat convex. Anterior end broadly rounded. Posterior end subtruncated. Ventral margin straightened. Sculpture consists of fine, closely set concentrics. Posterior umbonal ridge pronounced, slightly angular. Posterior slope short and steep. Sometimes there is a shallow, radial depression in front of the posterior umbonal ridge. Right hinge with two cardinals, the posterior one bifid, and two laterals, the anterior one close to the cardinals. Left hinge with two cardinals, the anterior one bifid, the posterior one small. Left laterals rudimentary. Posterior muscle scar sunken. Pallial sinus deep, confluent with pallial line, almost reaching the anterior muscle scar.

Holotype. — Natural History Museum Basel, No. G 13327.

Dimensions of holotype (right valve). — Length 10.8 mm, height 6.3 mm.

Type locality. — Melajo River area: KR 11862.

M. elinguis, n. sp. is abundant in the Melajo Clay as well as in the Courbaril beds. The Courbaril specimens usually grow somewhat larger.

This species closely resembles the form from the Miocene of Peru described as *Tellina (Angulus) pressa* Dall by Spieker (1922, p. 159, pl. 10, fig. 4) and as *Tellina (Eurytellina)* cf. *felix* Hanley by Olsson (1932, p. 123, pl. 14, fig. 8). The Peruvian form is larger than the Trinidad fossils and its antero-dorsal margin tends to be more convex. *M. apomsa* (Woodring) (1925, p. 170, pl. 23, figs. 19, 20) from Bowden, Jamaica, is a considerably smaller species with coarser sculpture. The Recent Pacific Coast *M. felix* (Hanley) (1844, p. 71; Olsson, 1961, p. 403, pl. 69, figs. 6, 6a) is somewhat larger and less pointed posteriorly.

Occurrence. — Melajo River area: EL 1810, K 9817, K 9903, KR 11862, RR 290, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 8399, K 12255, USGS 10991, USGS 20432, USGS 20432a, USGS 20434, USGS 21778.

Genus **EURYTELLINA** Fischer

Fischer, 1887, Manuel de Conchyliologie, p. 1147.

Type species (by monotypy), *Tellina punicea* Born.

Eurytellina punicea (Born) ?

Pl. 32, figs. 1-5

1780. *Tellina punicea* Born, Testacea Musei Caesarei Vindobonensis, p. 33, pl. 2, fig. 8.

1964. *Tellina (Eurytellina) punicea* Born, Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 335, pl. 48, figs. 14, 15, pl. 49, figs. 1, 2. For additional citations see this publication.

This species occurs frequently in the Courbaril beds but does not reach the size of Recent specimens. Immature valves look different, having a more rectangular outline, and an apparently more pronounced concentric sculpture. Recent immature valves of *E. punicea* are indistinguishable from those of the Courbaril beds. The concentric sculpture is usually obsolete on the umbonal region of adult *E. punicea*. Courbaril valves tend to be more flexed posteriorly than Recent specimens.

One immature valve from the Matura shell bed may belong to *E. punicea*. Fragments from the Melajo Clay are identified as *E. cf. punicea*.

Occurrence. — Point Courbaril: K 1429, K 8399, K 12013, K 12255, RR 120, PJ 212, USGS 20432, USGS 20432a, USGS 20434, USGS 21778. Matura Bay: JS 67 (?).

***Eurytellina melajoensis*, n. sp.**

Pl. 32, figs. 6-9

Shell of medium size, slightly twisted to the right postero-ventrally. Beaks low, situated little behind center. Dorsal margins straight. Anterior margin broadly rounded. Posterior end truncated, slightly emarginate. Posterior umbonal ridge low but well marked. Surface smooth except for fine incrementals which are stronger on posterior slope. Right hinge with two cardinals, the posterior one bifid. Laterals well developed, anterior one closer to the cardinals. Left hinge with an anterior bifid cardinal, and a posterior, rudimentary, laminar cardinal. Left laterals weak to obsolete. Pallial sinus deep, touching the anterior muscle scar, confluent with pallial line. Ligamental area narrow, lanceolate.

Holotype. — Natural History Museum Basel, No. G 13310.

Dimensions of holotype (right valve). — Length 23.8 mm, height 15.0 mm, convexity 3.0 mm.

Type locality. — Melajo River area: PJ 285.

This species is well represented in the Melajo Clay but less so in the Courbaril beds. Its outline is remarkably constant. On worn specimens fine, somewhat irregular, radial striae are visible.

The Recent *E. trinitatis* Tomlin (1929, p. 310) from Colón, Panama, has similar dimensions and the same proportions. It differs in having fine, concentric grooves, whereas *E. melajoensis*, n. sp. has no concentric sculpture except incrementals.

Occurrence. — Melajo River area: EL 1810, Hutch 51, KR 11862, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 8399, K 12013, K 12255, USGS 10991, USGS 20434.

***Eurytellina ? oligoscissulata*, n. sp.**

Pl. 33, figs. 1-4

Shell of medium size, almost equilateral, moderately inflated. Dorsal margins straight to slightly convex. Anterior end broadly rounded. Posterior end narrowly rounded. Ventral margin evenly curved. Posterior umbonal ridge inconspicuous. Sculpture consists

of incrementals. Anteriorly there are fine, equidistant, incised concentrics (about four per mm) which become oblique on the middle portion of the shell disc and then disappear posteriorly. Right hinge with two cardinals, the posterior one bifid, and two well-developed laterals, the anterior one closer to the cardinals. Left hinge with two cardinals, the anterior one bifid, the posterior one rudimentary, laminar. Left laterals weak. Ligamental area narrow. Pallial sinus deep, confluent with pallial line, not reaching the anterior muscle scar.

Holotype. — Natural History Museum Basel, No. G 13319.

Dimensions of holotype (left valve). — Length 22.0 mm, height 12.4 mm, convexity 2.8 mm.

Type locality. — Melajo River area: PJ 285.

The generic assignment of this species is somewhat questionable. On one hand it has the typical hinge and general shape of *Eurytellina*, on the other hand it has oblique lines on the surface recalling *Moerella* (*Scissula*). But it does not have the short, pronounced posterior slope of *Moerella*, and the zone of oblique lines crossing the incrementals is narrow looking like the beginning of a scissulation.

E. ? oligoscissulata somewhat resembles the rare Recent West Coast *Tellina* (*Scissula*) *nicoyana* Hertlein and Strong [1940-1951 (1949), p. 85, pl. 1, figs. 23-26], for which Olsson (1961, p. 409) erected the genus *Hertellina*. The Trinidad species is smaller, has a less convex postero-dorsal margin, and the zone of oblique sculpture is narrower.

Occurrence. — Melajo River area: Hutch 51, KR 11862, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, K 12255, USGS 10991, USGS 20432, USGS 20434, USGS 21778.

Genus **MERISCA** Dall

Dall, 1900, U. S. Nat. Mus., Proc., vol. 23, p. 290.

Type species (by original designation), *Tellina crystallina* Wood.

***Merisca trinidadensis*, n. sp.**

Pl. 33, figs. 5-9

Shell small, inequilateral, inequivalve, strongly inflated. Anterior side broadly rounded. Posterior part twisted to the right. Posterior end rostrate but less so in left valve. Left valve somewhat

more inflated than right valve. Right valve with a radial depression in front of the posterior umbonal ridge which is inconspicuous in left valve. Sculpture consists of closely spaced, lamellar concentrics. Right hinge with a small anterior and a trigonal, bifid, posterior cardinal. Laterals strong, almost equidistant from cardinals, with deep sockets above. Left anterior cardinal bifid, posterior one rudimentary. No left laterals. Lunule broad, better defined in left valve. Escutcheon sculptured by growth lines, bordered by a sharp ridge. Ligamental area narrow. Pallial sinus high and deep, almost reaching the anterior muscle scar; only half-way confluent with pallial line.

Holotype. — Natural History Museum Basel, No. G 13338.

Dimensions of holotype (right valve). — Length 12.1 mm, height 9.2 mm, convexity 2.8 mm.

Type locality. — Melajo River area: Hutch 51.

This species is represented by a number of right valves from the Melajo Clay. Although there is no double-valved specimen, the left valves at hand are thought to belong to the same species. Parts of the inner margins of lunule and escutcheon in the left valve seem to have the function of laterals as they are slightly thickened.

M. acrocosmia (Dall) [1890-1903 (1900), p. 1020, pl. 46, fig. 10] from Bowden, Jamaica, is a smaller species. It has radial threads between the concentrics which are lacking in *M. trinidadensis*, n. sp., and the radial depression in front of the posterior umbonal ridge is less pronounced. The Recent West Coast *M. margarita* Olsson (1961, p. 383, pl. 70, figs. 5, 5a) is a larger species with similar outline, but the pallial sinus is wholly confluent with the pallial line.

Most closely related to *M. trinidadensis*, n. sp. is the Recent Caribbean *M. martinicensis* (d'Orbigny) (1842, pl. 26, figs. 6-8; 1845, p. 305). It has about the same dimensions and outline. Its pallial features are the same (Warmke and Abbott, 1961, p. 196, text fig. 30b), but its postero-dorsal margin is almost straight, whereas in *M. trinidadensis* it is convex. In addition D'Orbigny's original figure shows radial striae between the concentrics.

Occurrence. — Hutch 51, K 9817, RR 290, PJ 285, USGS 18399, USGS 21178.

Genus **TELLIDORA** H. and A. Adams

H. and A. Adams, 1858, *Genera of Recent Mollusca*, vol. 2, p. 401.

Type species (by subsequent designation, Dall, 1900, *Wagner Free Inst. Sci. Philadelphia, Trans.*, vol. 3, pt. 5, p. 1037), *Tellina burneti* Broderip and G. B. Sowerby I.

Tellidora species

A number of fragments from the Melajo Clay belong to *Tellidora*, but a specific determination is not possible. Some hinges are preserved, but the entire outline of the shell cannot be reconstructed.

The Melajo species is close to the Recent Atlantic *T. cristata* (Recluz) (*Rev. Zool. Soc. Cuvierienne*, vol. 5, p. 270, 1842) and the Recent West American *T. burneti* (Broderip and G. B. Sowerby I) (*Zool Jour.*, vol. 4, No. 15, p. 362, pl. 9, fig. 2, 1829; Olsson, 1961, p. 381, pl. 69, figs. 1-1b).

Dall [1890-1903 (1900) p. 1037] put *T. lunulata* Holmes in the synonymy of *T. cristata*, whereas Olsson and Harbison (1953, p. 131) consider it a distinct species.

A species of *Tellidora* identified as *T. cristata* has been reported from the middle Miocene Gatun Formation of Costa Rica by Olsson (1922, p. 254, pl. 26, figs. 1, 2).

Occurrence. — PJ 285, USGS 18399, USGS 21178.

Genus **STRIGILLA** Turton

Turton, 1822, *Conchylia Insularum Britannicarum*, p. 117.

Type species (by subsequent designation, Gray, 1847, *Zool. Soc. London, Proc.*, pt. 15, p. 186), *Tellina carnaria* Linné.

Subgenus **STRIGILLA** s. str.

Strigilla (Strigilla) carnaria (Linné) ? Pl. 33, figs. 10, 11

1758. *Tellina carnaria* Linnaeus, *Systema Naturae*, ed. 10, p. 676.
 1864. *Strigilla carnaria* Linné, Guppy, *Trans. Sci. Assoc. Trinidad* for 1864, p. 36; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, p. 16.
 1867. *Strigilla carnaria* Linné, Guppy, *Proc. Sci. Assoc. Trinidad*, pt. 3, p. 162; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, p. 41.
 1874. *Strigilla carnaria* Linné, Guppy, *Geol. Mag.*, new ser., decade 2, vol. 1, p. 441.
 1964. *Strigilla carnaria* (Linnaeus), Weisbord, *Bull. Amer. Paleont.*, vol. 45, No. 204, p. 349, pl. 50, figs. 9-12, pl. 51, figs. 1-6. For additional citations see this publication.

S. carnaria ? was thought to be absent at Matura (Maury, 1925, p. 120), but it occurs in the Courbaril beds as well as in the Matura

shell bed. The fossils are smaller on an average, the sulci coarser, and their interspaces wider than in Recent specimens. It is questionable whether this should be considered as of subspecific value, because these features are variable to some degree in Recent shells. There are not enough fossil specimens, however, to show the variability which would allow their subspecific separation.

As to the wide spacing of the sulci the Trinidad fossils resemble the Recent West Coast *S. dichotoma* (Philippi) and *S. cicerula* (Philippi) as figured by Olsson (1961, pl. 73, figs. 2, 3).

Occurrence.—Point Courbaril: K 12255, USGS 20432, USGS 20432a, Matura Bay: USGS 18204, USGS 19860.

Distribution.—Pliocene and Pleistocene, Venezuela. Pleistocene, Alabama. Recent from North Carolina to Brasil, and on the West Coast from Panama to northern Peru.

Subgenus **PISOSTRIGILLA** Olsson

Olsson, 1961, Panamic-Pacific Pelecypoda (Paleont. Res. Inst., Ithaca, N.Y.), p. 390.

Type species (by original designation), *Tellina pisiformis* Linné.

Strigilla (Pisostrigilla) pisiformis (Linné)

Pl. 33, figs. 12-14

1758. *Tellina pisiformis* Linné, Systema Naturae, ed. 10, p. 677.

1925. *Strigilla pisiformis* Linnaeus, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 120, pl. 20, fig. 13.

1964. *Strigilla pisiformis* (Linnaeus), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 346, pl. 50, figs. 3-8. For additional citations see this publication.

This species is fairly common at Matura. Matura valves reach a length of 12 mm. *S. pisiformis* is most closely related to the Recent West Coast *S. panamensis* Olsson (1961, p. 390, pl. 39, figs. 8-8b).

Occurrence.—RR 230, USGS 18204, USGS 19860.

Distribution.—Miocene to Recent. For details see Weisbord (1964, p. 349).

Strigilla (Pisostrigilla ?) species

There is a single, left, small valve (length 4.5 mm) from the Courbaril beds with a peculiar sculpture. On the anterior part of the shell the incised lines are not curved as in the Recent West Coast *S. strata* Olsson (1961, p. 390, pl. 39, fig. 7), the type species of the subgenus *Simplistrigilla* Olsson. The same feature is present

on the upper Miocene (?) *S. galvestonensis* Harris (1895, p. 10, pl. 1, fig. 4) from Texas (Galveston well), *S. eutykta* Gardner and Aldrich (1919, p. 47, pl. 3, figs. 4, 8, 10) from the upper Miocene and Pliocene of the southeastern United States (see also Mansfield, 1932a, p. 139), and *S. georgiana* Gardner [1926-1950 (1928), p. 199, pl. 30, figs. 12, 13] from the Oak Grove Sand of Georgia.

The posterior slope of species belonging to *Pisostrigilla* is characterised by radial rows of acute angles formed by the incised lines. In *S. pisiformis* and other species there are two of these rows bordering a zone with parallel lines. On the valve from the Courbaril beds this zone is extremely narrow and visible only under a good lens.

Occurrence. — K 12255.

Genus **MACOMA** Leach

Leach, 1819, in John Ross, A voyage of discovery made under the orders of the Admiralty in His Majesty's ships *Isabella* and *Alexander* for the purpose of exploring Baffins Bay and inquiring into the probability of a north-west passage, Appendix II, p. LXII (not seen).

Type species (by monotypy), *Macoma tenera* Leach (= *Tellina calcarea* Gmelin).

Subgenus **PSAMMACOMA** Dall

Dall, 1900, U. S. Nat. Mus., Proc., vol. 23, No. 1210, p. 292.

Type species (by original designation), *Tellina candida* Lamarck.

Macoma (Psammacoma) species A

Pl. 34, figs. 1, 2

?1938. *Tellina couvaensis* Vokes, Amer. Museum Novitates, No. 988, p. 14, fig. 9.

Shell elongate, inequilateral. Dorsal margins straight, anterior end regularly curved. Posterior side short, truncated. Posterior umbonal ridge moderately pronounced. Sculpture consists of incrementals only. Pallial sinus deep, but not high, partly confluent with pallial line.

This form is represented from the Melajo Clay by a few incomplete valves. It may be the same as *Tellina couvaensis* Vokes from Springvale Quarry. *T. couvaensis* is based on the holotype only which is an incomplete specimen with its interior concealed by matrix.

M. olivella Dall [1890-1903 (1900), p. 1054, pl. 47, fig. 20;

Woodring, 1925, p. 177, pl. 24, figs. 20, 21] from Bowden, Jamaica, is also based on the holotype only which is an incomplete valve. It is easily distinguished from the Melajo species by its concave postero-dorsal margin and its longer ligamental area.

Occurrence.—USGS 18411, USGS 18634, USGS 21178 (?).

Macoma (Psammacoma) species B

Pl. 34, figs. 3, 4

A few valves occurring in the Courbaril beds have about the same size as *Macoma* species A from the Melajo Clay. However, they are less inflated and their posterior side is longer. The pallial sinus of the Melajo species is narrower and its posterior umbonal ridge more pronounced.

M. hybrida Weisbord (1964, p. 352, pl. 46, figs. 3, 4) from the Pliocene Mare Formation of Venezuela is known from the holotype only. It has a much shorter posterior side, a steeper posterior slope, and a smaller pallial sinus.

Occurrence.—USGS 20432.

Genus **PSAMMOTRETA** Dall

Dall, 1900, U. S. Nat. Mus., Proc., vol. 23, No. 1210, p. 292.

Type species (by original designation), *Tellina aurora* Hanley.

Psammotreta galbana, n. sp.

Pl. 34, figs. 5, 6

Shell of medium size, moderately inflated. Posterior side shorter than anterior one. Posterior end of right valve slightly flexed. Posterior umbonal ridge inconspicuous. Left valve with a shallow radial depression posteriorly which is not developed in right valve. Sculpture consists of incrementals which are more conspicuous on posterior area. Right hinge with a bifid cardinal posteriorly and a narrow cardinal anteriorly. Left hinge with a scarcely bifid anterior cardinal and a narrow posterior cardinal. Ligamental area short, but high. Anterior adductor scar larger than posterior one. Pallial sinus deep its highest point lying behind the beaks; partly confluent with pallial line.

Holotype.—USNM 645335.

Dimensions of holotype (right valve).—Length 37.8 mm, height 28.2 mm, convexity 7.7 mm.

Type locality.—Point Courbaril: USGS 20432.

P. galbana is represented by a few valves which occur only in

the Courbaril beds. It seems that no Recent species of *Psammotreta* has ever been recorded from the Western Atlantic. *P. galbana* is related to the Recent Eastern Pacific species.

P. aurora (Hanley) (1844, p. 147; Olsson, 1961, p. 411, pl. 74, figs. 6, 6a) is less inflated, less inequilateral, and the highest point of its pallial sinus lies below the beaks. *P. dombei* (Hanley) (1844, p. 144) and *P. gubernaculum* (Hanley) (1844, p. 142) reach considerably larger dimensions than *P. galbana*. *P. galbana* has about the same proportions as the form figured by Olsson (1961, pl. 74, figs. 8, 8a) as *Psammotreta* sp. (Pearl Islands, Panama) but is larger.

Occurrence. — K 12013, USGS 20432.

Genus **APOLYMETIS** Salisbury

Salisbury, 1929, Malac Soc. London, Proc., vol. 18, p. 258.

Type species (by original designation), *Tellina meyeri* Philippi (= *Tellina meyeri* Dunker).

Apolymetis trinitaria (Dall)

Pl. 34, figs. 7, 8

- 1900. *Metis trinitaria* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 5, p. 1041, pl. 46, fig. 24 (see also for further citations).
- 1910. *Telina sagrae* d'Orbigny, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, pp. 6, 12; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 149, 154.
- 1919. Not *Metis trinitaria* Dall, Cooke, Carnegie Inst. Washington, Pub. 291, p. 148, pl. 14, figs. 2a, 2b.
- 1920. Not *Metis trinitaria* Dall, Maury, New York Acad. Sci., Sci. Sur. Porto Rico and the Virgin Islands, vol. 3, pt. 1, p. 42.
- 1920. Not *Metis trinitaria* Dall, Hubbard, New York Acad. Sci., Sci. Sur. Porto Rico and the Virgin Islands, vol. 3, pt. 2, p. 125, pl. 10, fig. 7.
- 1925. *Metis trinitaria* Dall, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 121, pl. 22, figs. 1, 2, 8.
- 1925. Not *Metis trinitaria* Dall, Maury, Serv. Geol. Min. Brasil, Mon. No. 4, p. 357, pl. 19, fig. 3.
- 1929. *Metis trinitaria colombiensis* Weisbord, Bull. Amer. Paleont., vol. 14, No. 54, p. 24, pl. 5, fig. 6.
- ?1931. *Metis falconensis* H. K. Hodson, in Hodson and Hodson, Bull. Amer. Paleont., vol. 16, No. 59, p. 13, pl. 4, figs. 1, 4.
- 1931. *Metis colombiensis* Weisbord, Hodson and Hodson, Bull. Amer. Paleont., vol. 16, No. 60, p. 8, pl. 4, fig. 1 (holotype).
- 1938. *Metis trinitaria* Dall, Vokes, Amer. Museum Novitates, No. 988, p. 3.
- 1942. *Apolymetis colombiensis* (Weisbord), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 123, pl. 6, figs. 2, 3.

Lectotype (herewith selected). — USNM 115660.

Dimensions of lectotype. — Length 53 mm, height 42 mm, convexity (both valves) 21.6 mm.

This species occurs at the very base of the Melajo Clay but is rare. The material from Melajo is indistinguishable from that from Springvale Quarry, where the species is common.

Guppy had two specimens which he first labelled *Tellina biplicata* Conrad and later *Tellina sagrae*. The same specimens became Dall's type lot for his *Metis trinitaria*. They were collected in the type area of the Springvale Formation, and their color and adhering matrix show that they belong to the Savaneta Glauconitic Sandstone Member. Dall's figured specimen, the lectotype, is unusual in its proportions. None of the topotypes has such an elongate anterior part.

The remaining syntype (USNM 645187) is larger, less complete, but with almost centrally placed umbones. Typical topotypes are those figured by Rutsch (1942). Springvale specimens show a considerable variability. The proportions of length to height are not constant, *i.e.* subquadrate valves occur together with subrectangular ones. The deepness of the central, radial concavity of the right valve is variable to some degree. A second posterior umbonal ridge is, although not prominently, frequently developed. These variable features have been used to separate *A. falconensis* from *A. colombiensis*. Material from the middle Miocene of Colombia cannot be separated from the Trinidad fossils.

D'Orbigny's figures of *Tellina sagrae* (1852 ?, *Palaeontologia Cubana*, pl. 4, figs. 8, 9, 10) are based on an internal mold. According to Dall [1890-1903 (1900), p. 1043] it is the same as the Recent *Metis intastriata* Say (1826, p. 218).

It is difficult to separate *A. intastriata* from *A. trinitaria* according to the many Recent valves at hand. The fossils are always double-valved specimens. Fossil single valves, if available, might show that *A. trinitaria* is the same as the Recent species.

On the other hand *A. trinitaria* as mentioned and figured by Cooke (1919), Maury (1920), and Hubbard (1920) represents a different species. The collections of the U. S. National Museum contain many lots of that form from the early Miocene of Anguilla (Crocus Bay), Cuba (largest lots from La Cruz Formation near Santiago de Cuba) and Puerto Rico. This species differs from *A. trinitaria* in being constantly smaller and much more inequilateral.

Occurrence. — RR 291, USGS 18411, USGS 18634.

Distribution. — Middle Miocene of Colombia and Venezuela (?). Trinidad: Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm. (late Miocene).

Genus **TEMNOCONCHA** Dall

Dall, 1921, *Nautilus*, vol. 34, No. 4, p. 132.

Type species (by monotypy), *Psammacoma* (*Temnoconcha*) *brasiliiana* Dall.

Temnoconcha aff. **brasiliiana** (Dall)

Pl. 34, fig. 9; Pl. 35, figs. 1-3

Shell of medium size, thin and delicate, slightly inequilateral. Umbones low, situated a little behind center. Antero-dorsal margin slightly convex, postero-dorsal margin somewhat concave. Margin broadly rounded anteriorly, obliquely truncated and a little angulated posteriorly. Posterior umbonal ridge marked. Sculpture consists of incrementals which are conspicuous on posterior slope. Scissulation concentric anteriorly, oblique centrally, disappearing in front of umbonal ridge. Hinge with two cardinals in each valve, no laterals. Both right cardinals bifid. Anterior left cardinal bifid, posterior one rudimentary, thin. Ligamental area small, lanceolate.

The type locality of *T. brasiliiana* (Dall) (1921, p. 132) is San Sebastian Island off the southern coast of Brasil. The species has been discussed, and its holotype (USNM 333023) figured by Boss and Kenk (1964). Pallial line and sinus of the Trinidad fossils have the same shape as on Recent shells, but the fossil specimens never attain the size of Recent ones. The shells from Point Courbaril are more elongate than those from the Melajo Clay. The oblique lines are somewhat more widely spaced on the fossil specimens.

T. brasiliiana has been compared with the Recent Eastern Pacific *T. cognata* (C. B. Adams) (1852, p. 503) = *T. concinna* (C. B. Adams) (1852, p. 504) by Boss and Kenk. *T. cognata* essentially is a larger species. It has been recorded from the Pliocene of Ecuador by Pilsbry and Olsson (1941, p. 69). *T. ecuadoriana* Olsson (1961, p. 70, pl. 9, fig. 1) from the late Miocene to early Pliocene Borbon Formation of Ecuador is even larger than *T. cognata*.

The Trinidad fossils should possibly be identified as *T. cercadica* (Maury) (1917, p. 224, pl. 38, fig. 9) which has been described from the middle Miocene Cercado Formation of the

Dominican Republic. The collections of the U. S. National Museum contain only fragmentary topotypes, but *T. cercadica* seems to have similar dimensions as the Trinidad fossils.

Some specimens of probable middle Miocene age are contained in a lot from USGS Station 7996a: about midway between Boca del Canalete and Puerta de Arboletes, Caribbean coast of Colombia. They possibly represent *T. cercadica*.

Occurrence. — Melajo River area: EL 1810, USGS 18399, USGS 21178. Point Courbaril: K 1429, K 12255, PJ 212, USGS 20432, USGS 20434.

Family SEMELIDAE

Genus SEMELE Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, p. 165.

Type species (by monotypy), *Tellina reticulata* Spengler (= *Tellina proficua* Pulteney).

Semele proficua (Pulteney)

Pl. 35, figs. 4, 5

1799. *Tellina proficua* Pulteney, Hutch. Dorsetshire, p. 29, pl. 5, fig. 4 (not seen).

1925. *Semele proficua* Pulteney, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 117, pl. 21, fig. 5.

1964. *Semele proficua* (Pulteney), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 356, pl. 51, figs 9-14. For additional citations see this publication.

Like *S. purpurascens* this species occurs at Matura (rare) and in the Courbaril beds (frequent). The material at hand has thicker shells than Recent specimens, the valves are somewhat more inflated, and the chondrophore is deeper.

Occurrence. — Point Courbaril: K 8399, K 12013, K 12255, PJ 212, USGS 20432, USGS 20432a, USGS 21778. Matura Bay: RR 230.

Distribution. — Pliocene to Recent (see Weisbord, 1964, p. 358).

Semele purpurascens (Gmelin)

Pl. 35, figs. 6, 7

1791. *Venus purpurascens* Gmelin, Systema Naturae, ed. 13, vol. 1, pt. 6, p. 3288.

1867. *Semele variegata* Lamarck, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.

1874. *Semele variegata* Lamarck, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 441.

1925. *Semele purpurascens* Gmelin, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 117. Not pl. 20, fig. 17.

1964. *Semele purpurascens* (Gmelin), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 353, pl. 51, figs. 7, 8. For additional citations see this publication.

This species is rare at Matura as well as in the Courbaril beds.

Occurrence.—Point Courbaril: PJ 212, USGS 20432, USGS 10432a. Matura Bay: RR 230.

Distribution.—Late Miocene to Recent (see Weisbord, 1964, p. 356).

***Semele laevis costaricensis* Olsson**

Pl. 36, figs. 1, 2

1922. *Semele laevis* Sowerby var. *costaricensis* Olsson, Bull. Amer. Paleont., vol. 9, No. 39, p. 258, pl. 29, fig. 1.
1931. *Semele laevis costaricensis* Olsson, Hodson and Hodson, Bull. Amer. Paleont., vol. 16, No. 59, p. 17, pl. 8, fig. 5.
1932. *Semele laevis costaricensis* Olsson, Olsson, Bull. Amer. Paleont., vol. 19, No. 68, p. 126.
1942. *Semele laevis* Sowerby, var. *costaricensis* Olsson, Haas, Jour. Paleont., vol. 16, No. 3, p. 309.

Holotype.—Paleont. Research Inst., Ithaca, N. Y., No. 21287.

Type locality.—Hill 3, Banana River, Limón Prov., Costa Rica: Gatun Fm. (middle Miocene).

This species is represented from the Melajo Clay by two right valves and a fragment and from the Courbaril beds by one double-valved specimen and a hinge fragment.

S. laevis costaricensis essentially is a smaller form than the Recent *S. laevis* (G. B. Sowerby I) (*in* Broderip and Sowerby, 1832-1833, p. 199, 1833; Olsson, 1961, p. 361, pl. 64, fig. 6) from the west coast of Central America. The Melajo specimens have a somewhat narrower pallial sinus, and the right cardinal teeth are shorter and stouter. Large specimens of *S. laevis* have been recorded from the Pliocene Jama Formation of western Ecuador by Pilsbry and Olsson (1941, p. 70), and Olsson (1964, p. 65, pl. 9, fig. 9) mentioned *Semele* cf. *costaricensis* from the middle Miocene Angostura Formation of northwestern Ecuador.

S. laevis costaricensis occurs frequently in the Gransaul Clay Member of the Springvale Formation, but it does not seem to have been found in the Chickland Clay Member of the same formation.

Occurrence.—Melajo River area: USGS 18399, USGS 21178. Point Courbaril: USGS 10991, USGS 20432.

Distribution.—Costa Rica: Gatun Fm. (middle Miocene). Peru: Zorritos Fm. (middle Miocene). Venezuela: "upper middle

Miocene". Trinidad: Gransaul Clay Member and Melajo Clay Member, both of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm.

Semele claytoni couvensis Maury

Pl. 36, fig. 3

1925. *Semele claytoni* var. *couvensis* Maury, Bull. Amer. Paleont., vol. 10, No 42, p. 118, pl. 21, fig. 4.
 1938. *Semele claytoni couvensis* Maury, Vokes, Amer. Museum Novitates, No. 988, p. 3.
 1942. *Semele claytoni couvensis* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 122, pl. 5, fig. 4.

Holotype. — Paleont. Research Inst., Ithaca, N. Y., No. 888.

Type locality. — Springvale Quarry, Trinidad.

There is a single right valve from the base of the Melajo Clay. It is attached to matrix, but part of the hinge is visible showing clearly that it belongs to *Semele*. It is smaller than specimens from Springvale Quarry.

Topotypes of *S. claytoni* Maury (1917, p. 227, pl. 35, fig. 9) from the middle Miocene Cercado Formation of the Dominican Republic show that the subspecies *couvensis* has a less accentuated posterior umbonal ridge, and that its concentrics almost disappear toward the postero-dorsal margin.

S. leana Dall [1890-1903 (1900), p. 992, pl. 37, figs. 1, 2] from the Pliocene of Florida is a more inflated and inequilateral species with stronger radials between the concentrics. *S. perlamellosa* Heilprin (1887, p. 92, pl. 11, fig. 23) from the Pliocene of Florida is a much longer form compared to its height.

Occurrence. — USGS 18411.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm.

Semele aff. anteriocosta Vokes

Pl. 36, figs. 4-9

Shell of small to medium size, flattish, somewhat inequilateral. Umbones behind the middle, low. Dorsal margins almost straight. Anterior margin regularly rounded. Posterior end subtruncated. Prodissoconch smooth, glassy. First sculpture consists of narrow concentrics with wider interspaces followed by a number of coarser concentrics with wider interspaces as well. Subsequently the interspaces become narrower and sometimes irregular in width. Antero-dorsal portion of shell with a varying number of radial, incised lines crossing the concentrics. Postero-dorsal area with an inconspicuous

radial depression. Lunule small, sunken. Escutcheon elongate, narrow, with growth lines. Right hinge with two small cardinals and an elongate chondrophore behind them. One anterior and one posterior lateral teeth with a socket dorsally. Left hinge with two cardinals, the posterior one rudimentary. One anterior and one posterior lateral. Pallial sinus large.

This form occurs in the Melajo Clay, the Courbaril beds, and at Matura. *S. anteriocosta* Vokes (1938, p. 14, fig. 5) from the Savaneta Glauconitic Sandstone Member of the Springvale Fm. of Springvale Quarry is rare. Comparison with two topotypes shows that *S. aff. anteriocosta* is a consistently smaller form with finer concentric sculpture. Some Matura valves even tend to have a smooth surface during part of the ontogeny. The number of the radial, incised lines on the antero-dorsal part of the shell is variable.

If the variability of *S. anteriocosta* were known, the present material might prove to belong to that species. The specimen from Matura figured by Maury (1925, pl. 20, fig. 17) as *S. purpurascens* is *S. aff. anteriocosta*.

There are three species of *Semele* having the radial, incised lines like *S. anteriocosta*: *S. pulchra* (G. B. Sowerby I) (*in* Broderip and Sowerby, 1832-1833, p. 57, 1832; Olsson, 1961, p. 368, pl. 65, fig. 5), *S. guaymasensis* Pilsbry and Lowe (1932, p. 92, pl. 12, figs. 8, 9), both Recent Eastern Pacific species, and *S. quentinensis* Dall (1921, West American Scientist, vol. 19, No. 3, p. 22; Dall, 1925, p. 26, pl. 8, fig. 4) from the Pleistocene of Lower California, Mexico. *S. pulchra* is higher and trigonal in outline, *S. guaymasensis* has coarser concentrics, and *S. quentinensis* has a finer sculpture.

Occurrence.—Melajo River area: KR 11862, K 9817, USGS 18399, USGS 18411, USGS 21178. Point Courbaril: K 1429, K 12255, USGS 10991, USGS 20432a, USGS 20434. Matura Bay: RR 230, USGS 19860.

Genus **ABRA** Lamarck

Lamarck, 1818, Histoire naturelle des animaux sans vertèbres, vol. 5, p. 492.

Type species (by monotypy), *Macra tenuis* Montagu.

Abra cf. **aequalis** (Say)

Pl. 37, figs. 1-3

A number of partly broken valves from the Courbaril beds may belong to *A. aequalis* (Say) (1822, p. 307). According to the figures

given by Gardner [1943-1948 (1943), pl. 17, figs. 12-15] the outline is almost the same. The postero-ventral margin of the Trinidad shells is less regularly rounded being slightly angulated. The right hinge consists of two small, subequal cardinals in front of the oblique chondrophoral pit, and feeble lateral grooves. The anterior cardinal of the left valve is somewhat stronger than the posterior one; no laterals. Pallial sinus deep. Exterior surface almost smooth, some faint incrementals discernible.

A. aequalis is wide spread in North America and ranges from Miocene to Recent according to Gardner [1943-1948 (1943), p. 104]. The Recent *A. uruguayensis* (Pilsbry) (1897, p. 293, pl. 7, figs. 27-29) differs in details of the dentition and by its longer and straight antero-dorsal margin.

Occurrence. — K 1429, K 8399, K 12013, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 20433, USGS 20434, USGS 21778.

***Abra* ? species**

A few small, poorly preserved specimens from Matura mostly attached to matrix suggest a species of *Abra*. They differ from *Abra* cf. *aequalis* from the Courbaril beds not only by their smaller size but also in being more inequilateral.

Occurrence. — USGS 18204, USGS 19860.

Genus CUMINGIA G. B. Sowerby I

Sowerby, G. B. I, 1833, Zool. Soc. London, Proc., pt. 1, p. 34.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 187), *Cumingia lamellosa* G. B. Sowerby I.

***Cumingia galbensis*, n. sp.**

Pl. 37, figs. 4-6

Shell of small to medium size, inflated for the genus. Outline variable due to nestling mode of life. Umbones almost central. Anterior extremity broadly rounded, postero-ventral margin somewhat angulated. General aspect usually stout. Sculpture consists of almost equally spaced, concentric lamellae. Their interspaces with minute radial striae. Hinge with a large chondrophore, a small cardinal tooth in front of it, and two laterals. The right laterals are much larger. The anterior right lateral is the largest,

and is strongly projecting. Lunule relatively large. Pallial sinus partly confluent with pallial line.

Holotype. — USNM 645355.

Dimensions of holotype (right valve). — Length 13.5 mm, height 11.4 mm, convexity 4.6 mm.

Type locality. — Point Courbaril: USGS 20432.

This species occurs in the Courbaril beds only. Right and left valves are well represented.

Specimens in the collections of the U. S. National Museum labelled *C. tellinoides* Conrad from the Western Atlantic are longer, less inflated, and tend to have more distant concentrics. The Recent *C. coarctata* G. B. Sowerby I (1833-1834, p. 34, 1833) as figured by Abbott (1958, p. 136, pl. 5, 1, m), and by Olsson and Harbison (1953, p. 136, pl. 15, fig. 5) from the Pliocene of St. Petersburg, Florida, is a smaller form with more widely spaced concentrics. *C. amydra* Olsson and Harbison (1953, p. 136, pl. 15, fig. 6) from the Pliocene of Florida is known from a left valve only. It is smaller, and has more closely set concentrics than *C. galbensis*. A species of *Cumingia* in the collections of the U. S. National Museum occurring abundantly in the late Miocene of Acline, Florida, is considerably larger, proportionately longer, and less inflated.

C. galbensis resembles immature specimens of the Recent West Coast *C. lamellosa* G. B. Sowerby I (1833-1834, p. 34, 1833). They have the same degree of inflation and similar proportions. But *C. lamellosa* reaches a much larger size, and has coarser sculpture.

Occurrence. — K 8399, USGS 10991, USGS 20432, USGS 20432a, USGS 20434.

Family **DONACIDAE**

Genus **DONAX** Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 682.

Type species (by subsequent designation, Herrmannsen, April 18, 1847, *Indicis generum malacozoorum*, vol. 1, p. 404), *Donax rugosa* Linné.

Donax striatus Linné ?

Pl. 37, figs. 7, 8

1864. *Donax striata* Linné, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 36; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 16.

1867. *Donax striata* Linné, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 41.

D. striatus has been cited from Matura by Guppy already. The specimens at hand are strongly worn leaving sculptural details almost unrecognizable.

Some small valves occur in the Courbaril beds. Their shape and sculpture suggest that they may be immature *D. striatus*, and that they do not belong to *D. vagus* Weisbord (1964, p. 368, pl. 53, figs. 10, 11) nor to *D. marensis* Weisbord (1964, p. 369, pl. 53, figs. 12, 13), both small species from the Pliocene Mare Formation of Venezuela.

Occurrence. — Point Courbaril: K 1429, K 8399, PJ 212, USGS 10991, USGS 20433, USGS 20434. Matura Bay: JS 67, RR 230, PJ 302.

***Donax fabagelloides* Guppy**

Pl. 37, fig. 9; Pl. 38, figs. 1-4

1864. *Donax fabagella* Lamarck, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 36; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 16.
1867. *Donax fabagelloides* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 162, 173; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 41, 52.
1874. *Donax fabagelloides* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 435, 442, pl. 18, fig. 10.
1925. *Donax fabagelloides* Guppy, Maury, Bull. Amer. Paleont. vol. 10. No. 42, p. 115.

Shell of medium size, thin, elongate, inequilateral. Anterior side longer. Anterior and posterior ends narrowly arched. Ventral margin straight to slightly curved. Postero-dorsal margin straight. Antero-dorsal margin somewhat curved. Surface smooth, radially striated below outer layer. Posterior umbonal ridge inconspicuous. Right hinge with two cardinals, the posterior one triangular. Posteriorly there is a prominent socket for the left posterior lateral. Left hinge with two cardinals; posterior one bifid. Anterior lateral elongate, posterior lateral small, knoblike. Ligament external, sitting on a small platform giving the appearance of a third cardinal tooth in the right valve. Inner margin crenulated. Pallial sinus moderately deep, broadly rounded, partly confluent with pallial line.

Holotype. — USNM 115654.

Dimensions of holotype. — Length 20.5 mm, height 9.7 mm.

Type locality. — Matura, Trinidad.

The type specimen of *D. fabagelloides* is filled with matrix and its hinge cannot be seen. Compared with other Matura material the specimens of this species are astonishingly well preserved. The orig-

inal colour pattern is preserved in form of greyish, concentric bands of varying width. Outline and proportions of *D. fabagelloides* are constant.

D. fabagelloides seems to have no Recent analogue in the Caribbean area. *D. aequilibratus* Dall (1892, p. 126) from the Pliocene Waccamaw Formation of North Carolina [see Gardner, 1943-1948 (1943), p. 106, pl. 17, fig. 29] has a more accentuated posterior umbonal ridge and stronger radial sculpture. *D. punaensis* Pilsbry and Olsson (1941, p. 72, pl. 12, fig. 2) from the Pliocene of the north end of Puna Island, Ecuador, seems to differ from *D. fabagelloides* in minor details only. *D. punaensis* is not known enough yet. The Recent *D. gracilis* Hanley (1845a, p. 15) which ranges from the Gulf of California to northern Peru according to Olsson (1961, p. 341) has a higher anterior extremity, and its beaks are situated more posteriorly.

The above mentioned species seem to represent a uniform group well separated from other species of *Donax*. They all have inconspicuous sculpture and posterior umbonal ridge, and might be united in a supraspecific category.

Occurrence. — K 10924, JS 67, RR 230, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

Donax brightonensis, n. sp.

Pl. 38, figs. 5-8

Shell small, elongate, inequilateral. Beaks opisthogyrate. Anterior side longer. Posterior end more narrowly curved than anterior end. Dorsal margins inconspicuously curved. Posterior umbonal ridge moderately accentuated. Sculpture consists of radial striae below outer layer. Central part of shell disc with flattish, broad, somewhat irregular concentrics with narrower interspaces. Anteriorly and posteriorly the concentrics disappear. Right hinge with two cardinals; the posterior one triangular and inconspicuously bifid. Posteriorly there is a prominent socket for the left posterior lateral. Anterior lateral obscure. Ligamental platform looking like a third cardinal. Left hinge with two cardinals; posterior one bifid, anterior one triangular. Anterior lateral tooth elongate, posterior lateral knoblike. Inner margin crenulated.

Holotype. — Natural History Museum Basel, No. G 12861.

Dimensions of holotype (left valve). — Length 13.2 mm, height 6.1 mm.

Type locality. — Point Courbaril: RR 120.

D. brightonensis, n. sp. strikingly resembles *D. fabagelloides* Guppy from the Matura shell bed. But it is easily distinguished from it by the concentrics on the central portion of the shell disc which are lacking in *D. fabagelloides*. *D. brightonensis* further differs in the following minor points: the antero-dorsal margin is slightly curved instead of straight, the left anterior cardinal is heavier, and the posterior umbonal ridge is more pronounced.

Occurrence. — K 12255, RR 120, USGS 20432a.

Subgenus **MACHAERODONAX** Römer

Römer, 1870, Systematisches Conchilien-Cabinet, vol. 10, pt. 3, p. 77.

Type species (by subsequent designation, Dall, 1900, Wagner Free Inst. Sci Philadelphia, Trans., vol. 3, pt. 5, p. 963), *Donax scalpellum* Gray.

Donax (*Machaerodonax* ?) species

Pl. 37, figs. 10, 11

A single fragment from Matura suggests the subgenus *Machae-
rondonax*. Only the posterior part of a left valve including the hinge is preserved. The posterior ridge is sharp, the main shell disc smooth, and the postero-dorsal slope sculptured by finely beaded, radial riblets which are crossed by still finer concentrics.

This fragment seems to be most closely related to the Recent West Coast *D. transversus* G. B. Sowerby I (see Olsson, 1961, p. 345, pl. 59, figs. 4-4b). The sculpture on the posterior slope is almost the same, but the hinge differs in details. The Matura specimen seems to be immature as it does not show the slight sinus of the postero-dorsal margin marking the position of the posterior gap.

Occurrence. — USGS 19860.

Family **SANGUINOLARIIDAE**

Genus **TAGELUS** Gray

Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 189.

Type species (by original designation), *Solen guinensis* Chemnitz = *Solen gibbus* Spengler = *Solen plebeius* Lightfoot.

Subgenus **TAGELUS** s. str.

Tagelus (*Tagelus*) **plebeius** (Lightfoot)

1786. *Solen plebeius* Lightfoot, A catalogue of the Portland Museum, pp. 42, 101, 156. See Rehder, 1967, p. 11.

1964. *Tagelus plebeius* (Solander), Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 373, pl. 54, figs. 1-4. For additional citations see this publication.

This species is represented by a single, incomplete, left valve from the Courbaril beds.

Occurrence. — K 12255.

Distribution. — Late Miocene to Recent. For details see Weisbord (1964, p. 376).

Subgenus **MESOPLEURA** Conrad

Conrad, 1867, Amer. Jour. Conchology, vol. 3, app., p. 23.

Type species (by subsequent designation, Gardner, 1928, U. S. Geol. Sur., Prof. Paper 142-E, p. 214), *Solen bidentatus* Spengler (= *Solen divisus* Spengler).

Tagelus (Mesopleura) cf. divisus (Spengler) Pl. 38, figs. 9, 10

One small, but complete left valve from the Courbaril beds may be *T. divisus*. The internal, radial ridge in the umbonal cavity is well visible. It differs from Recent specimens in details only: the posterior extremity is somewhat higher, and the ventral margin slightly sinused, and not straight as in Recent shells.

Occurrence. — USGS 20434.

Tagelus (Mesopleura ?) mansfieldi (Vokes)

1938. *Psammosolen* (?) *mansfieldi* Vokes, Amer. Museum Novitates, No. 988, p. 15, fig. 13.

1942. *Tagelus* ? *mansfieldi* (Vokes), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 122.

Holotype. — Amer. Museum of Natural History, No. 24995.

Type locality. — Springvale Quarry, Trinidad.

A few incomplete valves of this species occur at the base of the Melajo Clay. A weak, radial ridge below the hinge indicates that they may belong to *Mesopleura*. *T. mansfieldi* is still insufficiently known. Only incomplete specimens are at hand, and most of them are attached to hard matrix.

Gardner [1926-1950 (1928), p. 215, pl. 32, fig. 27] recorded *T. cf. divisus* from the Chipola Formation of Florida, and a larger, unnamed species from the Shoal River Formation. Valves of *T. mansfieldi*, if complete, would reach a length of well over 50 mm, a length never attained by Recent specimens of *T. divisus*.

T. whitei Maury (1925a, p. 367, pl. 20, fig. 1) from the lower Miocene Pirabas Formation of Brasil is based on an insufficient fragment, and *T. hubbardi* Maury (1920, p. 44, pl. 7, fig. 3), from

the Collazo shales (San Sebastian shales: Oligocene) of Puerto Rico, is based on an internal mold.

T. cebus Olsson (1922, p. 261, pl. 29, fig. 9) from the middle Miocene Gatun Formation of Costa Rica is a smaller species. Its interior is unknown. *T. subaequalis* (Gabb) (1873b, p. 247; Pilsbry, 1922, p. 426, text fig. 48) from the middle Miocene of the Dominican Republic is a small (length 19 mm) *Mesopleura*.

T. lineatus Gabb (1881b, p. 370, pl. 47, fig. 71) from the Pliocene of Moín, Puerto Limón, Costa Rica, is a *Solecurtus*. *T. peruvianus* Pilsbry and Olsson (1941, p. 70, pl. 18, fig. 5) from the Pliocene Canoa Formation of western Ecuador is a much larger and heavier species than *T. mansfieldi*.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Genus **PLEIORYTIS** Conrad

Conrad, 1862, Acad. Nat. Sci. Philadelphia, Proc. for 1862, p. 286.

Type species (by monotypy), *Pleiorytis ovata* Conrad (= *Petricola centenaria* Conrad).

Pleiorytis caroniana (Maury)

Pl. 38, fig. 11

1925. *Petricola caroniana* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 122, pl. 20, fig. 16.

1929. *Asaphis delicatus* Weisbord, Bull. Amer. Paleont., vol. 14, No. 54, p. 25, pl. 5, figs. 4, 5.

1938. *Pleiorytis caroniana* (Maury), Vokes, Amer. Museum Novitates, No. 988, p. 15, fig. 11.

1965. *Pleiorytis caroniana* (Maury), Jung, Bull. Amer. Paleont., vol. 49, No. 223, p. 470, pl. 60, fig. 8.

Holotype. — Paleont. Research Inst., Ithaca, N. Y., No. 883.

Type locality. — Springvale Quarry, Trinidad.

This species is represented from the base of the Melajo Clay by a single, double-valved specimen. Length 56.7 mm, height 40.7 mm. The two valves are not entirely joint. Thus the left hinge with two cardinals and a large ligamental area behind them are partly visible. The holotype of *P. caroniana* is an immature, somewhat deformed, double-valved specimen measuring 25.7 mm in length.

Occurrence. — USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad. Middle Miocene of Venezuela and Colombia.

Family **SOLENIIDAE**Genus **SOLEN** Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 672.

Type species (by subsequent designation, Schumacher, 1817, *Essai d'un nouveau système des habitations des vers testacés*, p. 124), *Solen vagina* Linné.

Subgenus **SOLEN** s. str.**Solen (Solen)** species

Some small fragments of right valves from the Melajo Clay are available. The position of the cardinal tooth at the anteriormost extremity indicates that they belong to a species of *Solen* s. str.

Occurrence. — PJ 285.

Subgenus **SOLENA** Mörch

Mörch, 1853, *Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea Comes de Yoldi*, pt. 2, p. 7.

Type species (by subsequent designation, Stoliczka, 1871, *Palaeontologia Indica*, vol. 3, p. xvi), *Solen obliquus* Spengler.

Solen (Solena) obliquus Spengler

Pl. 38, fig. 14

1794. *Solen obliquus* Spengler, *Skrivt. Nat. Selsk. Copenhagen*, vol. 3, p. 92.

1925. *Solen (Solena) obliquus* Spengler, Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 115, pl. 18, fig. 12.

1964. *Solen (Solena) obliquus* Spengler, Weisbord, *Bull. Amer. Paleont.*, vol. 45, No. 204, p. 376, pl. 54, figs. 5, 6. For additional citations see this publication.

This species is represented by fragments from Matura and the Courbaril beds. The specimens are usually worn so that the surface sculpture is poorly preserved.

Occurrence. — Point Courbaril: K 12013. Matura Bay: JS 67, RR 230.

Distribution. — Miocene to Recent (see Weisbord, 1964, p. 378).

Family **CORBULIDAE**Genus **CARYOCORBULA** Gardner

Gardner, 1926, *Nautilus*, vol. 40, No. 2, p. 46.

Type species (by original designation), *Corbula alabamiensis* Isaac Lea.

Subgenus **CARYOCORBULA** s. str.**Caryocorbula (Caryocorbula) helenae** (Maury)

Pl. 38, figs. 12, 13;
Pl. 39, figs. 1-9

1912. *Corbula (Cuneocorbula) helenae* Maury, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 15, p. 62, pl. 9, fig. 25.
1925. *Corbula (Cuneocorbula) helenae* Maury, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 108, pl. 20, fig. 15.

Lectotype (herewith selected).—Cornell University, Paleont. Museum, Ithaca, N. Y., No. 33497.

Dimensions of lectotype (double-valved specimen).—Length 7.3 mm, height 5.0 mm.

Type locality.—A thousand feet west of the Brighton pier, near Pitch Lake, Trinidad.

The description of forms belonging to *Caryocorbula* from the younger Tertiary of Trinidad has been overdone. Several of these "species" are based on insufficient type material and should therefore be considered as *nomina dubia*.

The type of *C. helenae* itself is probably immature. A rich material from the type area is at hand including shells measuring up to 13 mm in length. This material shows a great variability: the concentrics are usually fine and closely set, but coarser, wider concentrics occur as well; the radial striae may be present or absent; the prominence of the posterior production and the posterior umbonal ridge is variable. An analogue variability can be observed in a single good sample of the Recent *C. caribaea* (d'Orbigny) (1842, pl. 27, figs. 5-8; 1845, p. 323), a species which *C. helenae* closely resembles.

C. smithiana (Maury) (1912, p. 63, pl. 9, figs. 29, 30) has been described from the same locality as *C. helenae*. Its lectotype (herewith selected: Pl. 39, figs. 1, 2) is the only specimen known. Specimens in the present material exactly analogous to *C. smithiana* are thought to fall within the variability of *C. helenae*.

C. caribaea pergrata (Maury) (1925, p. 103, pl. 20, fig. 8) from the Brighton area is known from a single specimen. It may belong to *C. helenae* or *C. caribaea*. *C. daphnis* (Maury) (1925, p. 104, pl. 20, figs. 10, 11) from Matura is known from two valves. Like the preceding it may belong to *C. helenae* or *C. caribaea*. Matura specimens are often worn so that the sculpture becomes obsolete.

Well-preserved and relatively large (up to 16 mm long) specimens of a *Caryocorbula* occur in the Melajo Clay. Provisionally they are identified as *C. helenae*. Their concentrics remain fine, and

the radial striation is present on most valves. They differ from Courbaril specimens by their larger size and by their somewhat more elongate shape.

The Melajo specimens closely resemble *C. urumacoensis* (F. Hodson) (in Hodson and Hodson, 1931a, p. 25, pl. 12, figs. 1-7) from the "upper middle Miocene" of Falcón, Venezuela. *C. urumacoensis* seems to lack the radial striation.

Occurrence.—Melajo River area: Hutch 51, KR 11862, PJ 285, USGS 18399, USGS 18411, USGS 18634, USGS 21178. Point Courbaril: K 1429, K 8399, K 12255, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778.

Distribution.—Melajo Clay Member of Springvale Fm. (?), Courbaril beds of Upper Morne l'Enfer Fm.

Caryocorbula (Caryocorbula) species

Pl. 39, fig. 10

A species of *Caryocorbula* occurs in great numbers at Matura, Point Courbaril, and in the Melajo River area. The specimens are small and variable. Generally they have a well-marked posterior umbonal ridge and concentric sculpture. The posterior production varies in shape from subtruncated to pointed. Radial striae are common but less so on Matura specimens.

Rutsch (1942, p. 102) listed *Caryocorbula* sp. ind. A and *Caryocorbula* sp. ind. B from Springvale Quarry. In a private report he characterised them by the presence and absence of radial striae respectively but stated that they might have to be united. The Springvale specimens are almost like the material under consideration.

The material from Matura represents what Maury (1925, p. 103) called immature *C. caribaea*. *C. arionis* (Maury) (1925, p. 111, pl. 19, figs. 11, 12, 17) from Matura is based on three specimens. Some rolled valves in the present material correspond with Maury's description and figures of *C. arionis* but are identified as *Caryocorbula* species.

Occurrence.—Melajo River area: EL 1810, Hutch 47, KR 11862, K 9797, K 9813, K 9816, K 9817, K 9902, K 9903, RR 290, RR 293, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, K 8399, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 20433, USGS 20434. Matura Bay: K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Genus **JULIACORBULA** Olsson and Harbison

Olsson and Harbison, 1953, Acad. Nat. Sci. Philadelphia, Mon. 8, p. 148.

Type species (by original designation), *Corbula cubaniana* d'Orbigny (= *Corbula knoxiana* C. B. Adams = *Corbula aequivalvis* Philippi).

Juliacorbula aequivalvis (Philippi)

Pl. 39, figs. 11-15

1836. *Corbula aequivalvis* Philippi, Archiv für Naturg., vol. 2, p. 227, pl. 7, fig. 4.
 1845. *Corbula cubaniana* d'Orbigny, in La Sagra, Historia fisica, politica y natural de la Isla de Cuba. Segunda parte, vol. 5, Moluscos, p. 322. Atlas, pl. 26, figs. 51-54, 1842.
 1867. *Corbula cubaniana* d'Orbigny, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 161; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 40.
 1874. *Corbula cubaniana* d'Orbigny, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 441.
 1925. *Corbula (Cuneocorbula) cubaniana* d'Orbigny, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 103, pl. 20, figs. 2, 3, 4.
 1964. *Corbula (Juliacorbula) aequivalvis* Philippi, Weisbord, Bull. Amer. Paleont., vol. 45, No. 204, p. 393, pl. 57, figs. 3-6. For further citations see this publication.

C. cubaniana and *C. knoxiana* C. B. Adams (lectotype figured by Clench and Turner, 1950, pl. 47, fig. 11) are usually treated as synonyms of *C. aequivalvis*. This procedure implies a considerable variability of *C. aequivalvis*. The Matura specimens vary in shape from subquadrate to subrectangular. The coarseness of the concentrics is variable as well. It must be emphasized, however, that subquadrate, strongly inflated valves are predominant at Matura. *J. aequivalvis* is rare in the Courbaril beds and in the Melajo Clay, but the specimens are like those from Matura.

J. aequivalvis stainforthi (Rutsch) (1942, p. 124, pl. 3, figs. 8, 9) from the Springvale Formation of Springvale Quarry is known from two valves only. They differ from *J. aequivalvis* only by their coarser concentrics.

J. knoxiana fossilis (Pilsbry) (1922, p. 427, pl. 46, fig. 14) from the middle Miocene of the Dominican Republic is said to differ from Recent specimens by its less projecting carina.

J. scutata (Gardner) [1943-1948 (1943), p. 140, pl. 23, figs. 26, 30-32] from the Pliocene of Florida and North Carolina is said to differ from *C. cubaniana* by its coarser sculpture. Matura specimens of *J. aequivalvis* mostly have coarser concentrics than Recent valves as well.

The Recent West Coast *J. bicarinata* (G. B. Sowerby I) (1833-1834, p. 35, 1833; Olsson, 1961, p. 436, pl. 75, figs. 6-6b) is also a short and stout species but is more trigonal than subquadrate in outline. The Recent *J. ira* (Dall) (1908, p. 423) from the Gulf of Panama may be the same as *J. bicarinata* according to Olsson (1961, p. 436, pl. 76, fig. 5).

Occurrence. — Melajo River area: PJ 285, Point Courbaril: K 1429, USGS 10991, USGS 20432. Matura Bay: K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Pliocene to Recent. See also Weisbord (1964, p. 396).

Genus **NOTOCORBULA** Iredale

Iredale, 1930, Australian Museum Records, vol. 17, No. 9, p. 404.

Type species (by original designation), *Notocorbula vicaria* Iredale.

Stenzel, Krause, and Twining (1957, pp. 169-170) expressed the opinion that *Varicorbula* Grant and Gale (1931, p. 420) should be considered as a synonym of *Notocorbula*.

Notocorbula islatrinitatis (Maury)

Pl. 40, figs. 1, 2

1925. *Corbula (Aloidis) isla-trinitatis* Maury. Bull. Amer. Paleont., vol. 10, No. 42, p. 101, pl. 19, figs 1, 8, 9, 10.

1938. *Corbula (Corbula) isla-trinitatis* (Maury), Vokes, Amer. Museum Novitates, No. 988, p. 3.

1942. *Corbula isla-trinitatis* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 102.

Lectotype (herewith selected). — Paleont. Research Inst., Ithaca, N.Y., No. 909 (specimen figured by Maury, 1925, pl. 19, fig. 9).

Dimensions of lectotype. — Length 18.1 mm, height 16.1 mm, convexity 9.5 mm.

Type locality. — Springvale Quarry, Trinidad.

This species is but poorly represented from the Melajo Clay. *N. islatrinitatis* is abundant at Springvale Quarry. The Melajo specimens do not reach the size of topotypes.

The type and only specimen of *N. prenuncia* (Spieker) (1922, p. 172, pl. 10, fig. 12) (USNM 562439) from the Miocene Zorritos Fm. of Peru is a smaller species. It is considerably higher than long. *N. heterogena* (Dall) [1890-1903 (1898), p. 850, pl. 46, fig. 15;

Woodring, 1925, p. 187, pl. 26, figs. 1-4] from Bowden, Jamaica, essentially is a smaller species with finer concentric sculpture.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Brasso Fm. (Maury), Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Notocorbula species

Pl. 40, figs. 3, 4

A few right, partly immature valves from the Melajo Clay differ from *N. islatrinitatis* in having a decidedly finer concentric sculpture and in being more produced posteriorly. Some valves have fine, radial striae in young stages.

Occurrence. — PJ 285, USGS 18399, USGS 21178.

Notocorbula aff. disparilis (d'Orbigny)

Pl. 40, figs. 5, 6

The *Notocorbula* occurring in the Matura shell bed is identified as *N. aff. disparilis*. This is unsatisfactory, because the Recent species of *Notocorbula*, for which several names have been used, are not sufficiently defined. In addition a number of Caribbean Tertiary species of *Notocorbula* are based on insufficient material.

The numerous lots in the collections of the U. S. National Museum labelled *disparilis* show constant differences from Matura lots. Matura specimens may reach a larger size, their concentrics are coarser, and their posterior umbonal ridge is less angulated than in Recent specimens. Specimens from the Pliocene of Moín Hill, Costa Rica, seem to be closer to the Recent species than to Matura valves.

Guppy (1867, p. 161; 1874, p. 441) as well as Dall [1890-1903 (1898), p. 849] cited the Matura *Notocorbula* as *Corbula vieta*. The type lot of *C. vieta* Guppy (1866b, p. 580, pl. 26, fig. 8) from the middle Miocene Manzanilla Formation of Trinidad consists of nine right valves (USNM 115650). The type lot of *Erycina tensa* Guppy (1866b, p. 582, pl. 26, fig. 6), also from the Manzanilla Formation, consists of four specimens (USNM 115652). They represent the left valves of *C. vieta* (see also Woodring, 1925, p. 188).

The new material from Matura contains only one left valve. It is incomplete and worn so that the radials are obsolete. Right valves from Matura are usually more produced posteriorly than

right valves of *C. vieta* from Manzanilla, and their posterior angulation is more pronounced.

N. bruscasensis (Weisbord) (1964, p. 399, pl. 46, figs. 5, 6) from the Pliocene Playa Grande Formation as well as *N. puntagordensis* (Weisbord) (1964, p. 401, pl. 57, figs. 15, 16) from the Pliocene Mare Formation of Venezuela are both based on a single, immature, left valve. *N. granti* (Olsson) (1942, p. 45, pl. 2, figs. 8, 9) from the Pliocene Charco Azul Formation of Panama does not have any radials on the left valve.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Genus **TENUICORBULA** Olsson

Olsson, 1932, Bull. Amer. Paleont., vol. 19, No. 68, p. 141.

Type species (by original designation), *Corbula tenuis* G. B. Sowerby I.

Tenuicorbula melajoensis, n. sp.

Pl. 40, figs. 7-9

Shell of medium size, thin, elongate, inequilateral, slightly inequivalve. Umbones low. Anterior end produced, strongly curved. Posterior end obliquely truncated. Ventral margin almost straight. Right valve a little larger than left valve. Central part of shell with a shallow, radial depression. Sculpture consists of concentrics which become lamellar antero-ventrally. Interspaces wider, with incrementals. The concentrics weaken toward the sharply elevated, posterior umbonal ridge. This ridge carries beadlike thickenings, where it is crossed by the concentrics. The concentrics are thicker and less numerous on the posterior slope which is bordered dorsally by another sharp ridge. Right valve with a hook-shaped cardinal. Left valve with a grooved, projecting, chondrophoral plate. No lunule. Escutcheon conspicuous, sculptured by growth lines.

Holotype. — Natural History Museum Basel, No. G 14047.

Dimensions of holotype (right valve). — Length 20.0 mm, height 9.6 mm.

Type locality. — Melajo River area: Hutch 51.

This species occurs in the Melajo Clay. It is rare being represented by a few complete valves and some fragments. The posterior keel may project some distance over the postero-ventral margin as a rostrum.

T. melajoensis is at once distinguished from the Recent West Coast *T. tenuis* (G. B. Sowerby I) (1833-1834, p. 36, 1833; Olsson, 1961, p. 434, pl. 77, figs. 3, 3a), its subspecies *lupina* (Olsson) (1932, p. 143, pl. 14, figs. 7, 10) from the Tumbes Fm. of Peru, and the shell described as *T. aff. tenuis lupina* from the upper middle Miocene of the Paraguaná Peninsula, Venezuela (Jung, 1965, p. 477, pl. 62, figs. 8, 9), by its much coarser concentric sculpture.

T. acutirostra (Spieker) (1922, p. 176, pl. 10, figs. 18, 19) and its subspecies *zorritensis* (Olsson) (1932, p. 144, pl. 14, fig. 3), both from the Zorritos Formation of Peru, are shorter forms with finer sculpture.

Occurrence.—Hutch 47, Hutch 51, K 9817, PJ 285, USGS 18399, USGS 21178.

***Tenuicorbula* aff. *melajoensis*, n. sp.**

Pl. 40, figs. 10, 11

A single, incomplete, left valve from Matura has about the same dimensions as *T. melajoensis*. It differs from that species by its shorter anterior end, *i.e.* its antero-dorsal margin is steeper. Its concentrics are somewhat lower which is probably due to washing.

Occurrence.—PJ 302.

Family **PHOLADIDAE**

Genus **PHOLAS** Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 669.

Type species (by subsequent designation, Children, 1822). *Pholas dactylus* Linné (see Turner, 1954, p. 44).

Pholas species

Two small fragments from the Courbaril beds represent the septate umbonal reflection.

The type specimen of *P. mackiana* Maury (1912, p. 64, pl. 9, fig. 31) from 700 feet east of the Brighton pier near the Pitch Lake, Trinidad, is at hand and refigured here (Pl. 40, fig. 12). It is a fragment representing the anterior part of the shell with the septate umbonal reflection. A definite comparison with *P. campechiensis* Gmelin (see Turner, 1954, p. 48) and *P. chiloensis* Molina (Turner, 1954, p. 51) is not possible as the specimen is too incomplete. The anterior radials are considerably broader, and the anteriormost radial is situated much closer to the antero-dorsal margin than in the two Recent species. The specimen of *P. chiloensis* figured by

Olsson (1961, pl. 78, fig. 4) seems to have broader anterior radials than is usual. *P. mackiana* may be a valid species, if broad anterior radials do not prove to fall within the variability of one of the above mentioned species.

Occurrence. — PJ 212, USGS 20434.

Genus **MARTESIA** G. B. Sowerby I

Sowerby, G. B., I, 1824, Genera of Recent and Fossil Shells, part 23, *Pholas*, p. 2.

Type species (by monotypy), *Pholas clavata* Lamarck (= *Pholas striatus* Linné).

Martesia striata (Linné) ?

Fragments of the umbonal region from the Courbaril beds suggest *M. striata*. They show the umbonal-ventral sulcus, and the discrepant sculpture is indistinguishable from that of Recent specimens.

M. oligocenica Maury (1912, p. 65, pl. 9, figs. 32, 33) from a locality just south of the Pitch Lake, Trinidad, belonging to the Upper Morne l'Enfer Formation probably represents *M. striata*. This locality yields only internal molds. A syntype at hand which is refigured here (Pl. 40, fig. 13) is smaller than that figured by Maury. It shows the umbonal-ventral sulcus and the anterior margin of the shell which separates the anterior part of the shell from the callum. Obscure traces of sculpture are preserved on the anterior slope. *M. oligocenica* should be treated as a *nomen dubium*.

M. striata has also been cited from Matura by Guppy (1867, p. 161; reprint, Harris, 1921, p. 40; and 1874, p. 441).

Occurrence. — PJ 212, USGS 20432, USGS 20433, USGS 20434.

Family **PANDORIDAE**

Genus **PANDORA** Bruguière

Bruguière, 1797, Encycl. Méth., Vers Testacés, vol. 2, pl. 250, figs. 1a-c.

Type species (by subsequent monotypy, Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 88), *Tellina inaequivalvis* Linné. See also Boss and Merrill (1965, pp. 189-190).

Pandora species

A single, broken left valve from the Melajo Clay is available. The hinge is not visible, because the specimen is attached to matrix.

Length 24.5 mm (incomplete), height 15 mm (incomplete). The posterior submargin carries one carina, and the external sculpture consists of weak, concentric undulations. A second postero-dorsal ridge is not visible, because the margin is incomplete.

The state of preservation of this fragment does not allow one to point out specific affinities. However, it seems to belong to the group of *P. crassidens* Conrad which has been recorded from the Miocene of Maryland, Virginia, North Carolina, and Florida, and the Pliocene of North Carolina [see Gardner, 1943-1948 (1943), p. 47], and the Recent *P. gouldiana* Dall which ranges from Gaspé to North Carolina, according to Boss and Merrill (1965, p. 194). Olsson and Harbison (1953, p. 65) recorded a *Pandora* from the Pliocene of St. Petersburg, Florida, which they thought to be intermediate between *P. crassidens* and *P. gouldiana*.

Occurrence. — USGS 21178.

GASTROPODA

Family FISSURELLIDAE

Genus DIODORA Gray

Gray, 1821, London Medical Repository, Monthly Journal and Review, vol. 15, p. 233.

Type species (by monotypy), *Patella apertura* Montagu (= *Patella graeca* Linné).

Diodora cayenensis (Lamarck)

Pl. 41, figs. 1-3

1822. *Fissurella cayenensis* Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 6, pt. 2, p. 12.

1822. *Fissurella alternata* Say, Acad. Nat. Sci. Philadelphia, Jour., ser. 1, vol. 2, pt. 2, p. 224.

1867. *Fissurella cayennensis* Lamarck, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 160; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 39.

1874. *Fissurella cayennensis* Lamarck, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 441.

?1917. *Fissuridea henekeni* Maury, Bull. Amer. Paleont., vol. 5, No. 29, p. 157, pl. 24, fig. 21.

1917. *Fissuridea alternata* Say, Maury, *ibidem*, p. 157, pl. 24, fig. 22.

1925. *Fissuridea alternata* Say, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 249, pl. 43, fig. 1.

1928. *Diodora alternata henekeni* (Maury), Woodring, Carnegie Inst. Washington, Pub. 385, p. 452, pl. 39, figs. 11-17.

1943. *Diodora cayenensis* Lamarck, Pérez Farfante, Johnsonia, vol. 1, No. 11, p. 5, pl. 2, figs. 1-6.

1953. *Diodora cayenensis* (Lamarck), Olsson and Harbison, Acad. Nat. Sci. Philadelphia, Mon. No. 8, p. 359, pl. 63, fig. 5.

1962. *Diodora cayenensis* (Lamarck), Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 50, pl. 2, figs. 15-20. For further citations see this publication.

This species is represented from Point Courbaril and Matura. Matura shells show a considerable variability as to height and convexity of the posterior slope. According to Recent specimens and literature the coarseness of the radials seems to be variable as well. The Matura specimens are usually small but may reach 25 mm in length.

D. compsa Woodring (1928, p. 454, pl. 39, figs. 18-20) from Bowden, Jamaica, is based on a single small specimen which is separated from *D. cayenensis* by its clearly finer sculpture. *D. dorsenula* Weisbord (1962, p. 58, pl. 3, figs. 18, 19), from the Pliocene Mare Formation of northern Venezuela, is based on a single worn fragment of the apical area and is virtually unrecognizable.

Occurrence. — Point Courbaril: K 1429, USGS 10991, USGS 20432, USGS 20434, USGS 21778. Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Miocene to Recent (see also Weisbord, 1962, p. 53).

Diodora (?) species

Pl. 41, figs. 4, 5

A single worn specimen from Matura differs from *D. cayenensis* in having less, but more prominent, primary radials and an oval orifice. The generic position of this shell is not clear as the posterior truncation of the internal callus is not recognizable. This, however, may be due to washing; if not, it would represent a *Fissurella*.

Occurrence. — RR 230.

Family ACMAEIDAE

Genus ACMAEA Eschscholtz

Eschscholtz, 1830, in Kotzebue, Neue Reise um die Welt in den Jahren 1823, 24, 25 und 26, vol. 2, Appendix, p. 24.

Type species (by subsequent designation, Dall, 1871, Amer. Jour. Conch., vol. 6, pt. 3, p. 238), *Acmaea mitra* Eschscholtz.

Acmaea species

There are two worn and partly damaged specimens from Matura. The external sculpture consists of about 15 radial ridges. The larger specimen is 7.2 mm long, and its horseshoe-shaped muscle scar is well recognizable.

Occurrence. — JS 67, USGS 19860.

Family **TROCHIDAE**Genus **CALLIOSTOMA** Swainson

Swainson, 1840, Treatise on Malacology, pp. 218, 351.

Type species (by monotypy), *Trochus zizyphinus* Linné.

Many subgeneric names have been proposed for *Calliostoma*. There seems to be no satisfactory classification based on shell morphology. Clench and Turner (1960) introduced two subgeneric names based on differences of the jaws. Until there will be a system correlating differences in anatomy with those of shell morphology (if this is possible), it seems best to omit subgeneric assignments, a conclusion also reached by Stadt (1956).

Calliostoma decipiens (Guppy)

Pl. 41, figs. 6-12

1867. *Trochus decipiens* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 172; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 51.
1874. *Trochus decipiens* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 435, pl. 18, fig. 18; p. 441 (part: not from Bowden).
1903. Not *Calliostoma decipiens* Guppy, Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 6, p. 1585.
1925. *Calliostoma decipiens* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 244, pl. 43, fig. 9.

Shell of medium size, conical. Protoconch consists of about one volution. Early sculpture consists of three spirals carrying nodules. The nodules are connected by prosocline lines which disappear on later whorls. Additional granulated spirals are introduced alternating in size with the primary ones. Immature specimens may have an open umbilicus, whereas in the adult stage it is closed by callus. The periphery of the volutions is usually slightly keeled. Base of whorls covered by many spirals, the more central ones granulated.

Lectotype (herewith selected). — USNM 115619.

Dimensions of lectotype. — Height 8.7 mm, diameter 11.7 mm.

Type locality. — Matura, Trinidad.

The type lot of *C. decipiens* consists of two specimens. One of them is incomplete. *C. decipiens* shows some variation as to the sharpness of the peripheral angulation and the intensity of the granulation of the spirals. It is common at Matura but rare in the Melajo Clay.

C. decipiens has some affinities to the Recent Atlantic *C. adpersum* (Philippi) (see Clench and Turner, 1960, p. 46, pls. 30,

31) and *C. euglyptum* (A. Adams) (Clench and Turner, 1960, p. 48, pl. 32).

Occurrence. — Melajo River area: PJ 285, USGS 18411, Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm. (rare). Matura shell bed.

***Calliostoma laticarinatum* (Guppy)**

Pl. 41, figs. 13-17

1864. *Trochus granulatus* Born. Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.

1867. *Trochus decipiens laticarinatus* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 172; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 51.

1874. *Trochus decipiens laticarinatus* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 435, pl. 18, fig. 19.

1925. *Calliostoma decipiens laticarinatum* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 245, pl. 43, figs. 5, 10.

Holotype. — USNM 115618.

Dimensions of holotype. — Height 9.7 mm, diameter 11.4 mm

Type locality. — Matura, Trinidad.

This form is separated from *C. decipiens* by its sharper angulation at the periphery of the whorls. The distance between angulation and suture is larger in *C. laticarinatum*. Moreover the whorls tend to be more concave above the angulation. However, the protoconch and the early whorls are the same in both forms. There are some transitional shells in the material at hand. This may indicate that they should be synonymised. But examination of further material is needed.

Worn specimens having almost no external sculpture left somewhat resemble the larger Pliocene *C. nonurum* Pilsbry and Olsson (1941, p. 46, pl. 8, figs. 7, 10, 11) from Ecuador which has also been found in the Recent fauna of northern Peru. *C. caronianum* Maury (1925, p. 245, pl. 43, fig. 8) from the late Miocene Springvale Fm. of Trinidad differs from *C. laticarinatum* by its smaller apical angle and its more concave whorls. *C. caribbeanum* Weisbord (1962, p. 70, pl. 4, figs. 8-10) from the Pliocene Mare Fm. of northern Venezuela is said to differ from *C. laticarinatum* by its larger apical angle.

Occurrence. — RR 230, PJ 302, USGS 19860.

Distribution. — Known from type locality only.

***Calliostoma caronianum* Maury**

Pl. 41, figs. 22, 23

1925. *Calliostoma caronianum* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 245, pl. 43, fig. 8.

1938. *Calliostoma (Calliostoma) caroniana* Maury, Vokes, Amer. Museum Novitates, No. 988, p. 5.
 1942. *Calliostoma caronianum* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 102.

Holotype. — Paleont. Research Inst., Ithaca, N.Y., No. 1110.

Type locality. — Springvale Quarry, Trinidad.

This species is represented by a single specimen from the base of the Melajo Clay. As mentioned above it is related to *C. latincarinatum* but differs from that species in having a smaller apical angle and in being proportionately higher.

C. attrinum Mansfield (1925, p. 58, pl. 10, figs. 7, 8) from the (middle ?) Miocene of Trinidad has about the same proportions and outline as *C. caronianum*, but its sculpture is much coarser.

Occurrence. — USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member, and Melajo Clay Member, both of Springvale Fm., Trinidad.

***Calliostoma plicomphalus* (Guppy)**

Pl. 41, figs. 18-21

1867. *Trochus plicomphalus* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 161, 173; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 40, 52.
 1874. *Trochus plicomphalus* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 435, 441, pl. 18, fig. 17.
 1925. *Calliostoma (Eutrochus) plicomphalus* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 246, pl. 43, figs. 11, 13, 15.

Shell of medium size. Protoconch consists of a little more than one volution. First sculpture with two and after half a volution with three spirals which are crossed by slightly prosocline axials forming beads at the intersections. The axials disappear soon and additional granular spirals are introduced. Aperture rhombic. Umbilicus open. Periphery usually rounded, not angular. Base sculptured by numerous spirals; the outer ones smooth, but toward the umbilicus the beads gradually increase in size. The spiral bordering the umbilicus carries still larger beads.

Lectotype (herewith selected). — USNM 115617.

Dimensions of lectotype. — Height 11.2 mm, diameter 12.2 mm.

Type locality. — Matura, Trinidad.

Immature specimens are usually flat-sided, but adult shells have somewhat convex whorls. The periphery is angulated in young individuals but rounded later. The width of the umbilical opening and the apical angle are not constant.

As stated by Maury this species has some resemblance to the

Recent West Indian *C. jujubinum* (Gmelin) (Clench and Turner, 1960, p. 31, pl. 21), but that species has a sharper periphery, and the adult whorls tend to be concave, whereas in *C. plicomphalus* they are convex. Clench and Turner noted a considerable variability of *C. jujubinum* as to apical angle and width of the umbilicus.

Occurrence. — JS 67, RR 230, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

***Calliostoma olssoni* Maury**

Pl. 42, figs. 1-3

1925. *Calliostoma (Eutrochus) olssoni* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 247, pl. 43, figs. 6, 14.

Shell of medium size. Apical angle large. Protoconch consists of one volution. First sculpture with three spirals and prosocline axials which soon produce beads at the intersections. After about $11\frac{1}{2}$ volutions the axials disappear and additional beaded spirals are intercalated which tend to alternate in size with the primary spirals. The uppermost spiral of the whorl carries larger beads than the others. Periphery sharply angulated. Base covered by spirals. The two to four central ones granulated, the others narrower, smooth, with concave interspaces.

Lectotype (herewith selected). — Paleont. Research Inst., Ithaca, N.Y., No. 1108.

Dimensions of lectotype. — Height 7.5 mm, diameter 12.3 mm.

Type locality. — Matura, Trinidad.

This species is not frequent at Matura, whereas in the Melajo Clay it is common. From Point Courbaril it is represented by a single immature shell. Its characters are constant, although the Melajo specimens tend to have a smaller apical angle than topotypes. The two syntypes figured by Maury are immature. The larger specimen (fig. 6) is here selected as lectotype.

C. olssoni with its large apical angle and the spiral just below the suture carrying conspicuous beads is a distinctive species. No allied forms have been found.

Occurrence. — Melajo River area: Hutch 47, Hutch 51, EL 1810, KR 11862, K 9817, K 9902, RR 290, PJ 285, USGS 18399, USGS 21178. Point Courbaril: PJ 212. Matura Bay: K 10924, JS 67, RR 230, USGS 18204, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Genus **MICROGAZA** Dall

Dall, 1881, Bull. Mus. Comp. Zool., vol. 9, p. 50.

Type species (by monotypy), *Callogaza (Microgaza) rotella* Dall.

Microgaza oblita, n. sp.

Pl. 42 figs. 4-9

1867. *Solarium semidecussatum* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 170; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 35, 49. Part.

1874. *Solarium semidecussatum* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 408 (part); not pl. 18, fig. 14.

Shell small, with four to five whorls. Protoconch consisting of $1\frac{1}{4}$ smooth volutions. Early sculpture with prosocline axials which are restricted to the uppermost part of the whorls after about one volution. At the same time a spiral appears just below the suture carrying the former prosocline axials in form of beads. Their interspaces become larger with increasing age. Whorls sharply angulated at periphery. Base strongly convex and smooth except the umbilical margin which carries short, radial wrinkles crossed by two to four faint spiral grooves. Inside of umbilical wall with a number of spirals. Aperture subquadrate. Inner lip with callus.

Holotype. — USNM 645185.

Dimensions of holotype. — Height 2.1 mm, diameter 4.2 mm.

Type locality. — Matura, Trinidad.

This species is represented by a few specimens only. Most of them are worn resulting in an indistinct sculpture. As mentioned by Woodring (1928, p. 358) the type lot of *Solarium semidecussatum* Guppy (USNM 115468) consists of two specimens. One of them is the holotype of *Architectonica (Pseudotorinia) semidecussata* and the other one the holotype of *Microgaza oblita*, n. sp.

A closely related form has been described as *M. rotella vetula* from the Bowden Formation of Jamaica by Woodring (1928, p. 435, pl. 37, figs. 1-3). The many topotypes at hand show that both species have about the same apical angle, but the whorls of *M. oblita* are higher. Moreover the Jamaican species has more closely set beads on the spiral just below the suture, and the wrinkles bordering the umbilicus are longer and not crossed by spiral grooves. *M. oblita* lacks the fine spiral threads on and near the periphery of the body whorl.

The Recent West Indian *M. rotella* (Dall) (1881, p. 51) has

considerably weaker radial wrinkles at the umbilical margin. According to Dall's figures (1889a, pl. 22, figs. 5, 5a) its periphery is not angulated.

Occurrence. — JS 67, RR 230, PJ 302, USGS 19860.

Distribution. — Known from type locality only.

Family **TURBINIDAE**

Genus **ASTRAEA** Röding

Röding, 1798, Museum Boltenianum, pt. 2, p. 79.

Type species (by subsequent designation, Suter, 1913, Manual of New Zealand Mollusca, p. 166), *Trochus imperialis* Gmelin (= *Trochus heliotropium* Martyn).

Subgenus **ASTRALIUM** Link

Link, 1807, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, p. 135.

Type species (by subsequent designation, Woodring, 1928, Carnegie Inst. Washington, Pub. 385, p. 412), *Astralium deplanatum* Link (= *Trochus costulatus* Lamarck).

Astraea (Astralium) cf. brevispina (Lamarck) Pl. 42, figs. 10, 11

The few specimens from Matura are immature and too incomplete to allow a definite determination.

A. brevispina basalis (Olsson) (1922, p. 162, pl. 15, figs. 4, 5) from the Gatun Formation of Costa Rica, which has also been recorded from the Bowden Formation of Jamaica by Woodring (1928, p. 413, pl. 33, figs. 4-6), mainly differs from the Recent *A. brevispina* (Lamarck) (see Weisbord, 1962, p. 94, pl. 6, figs. 16-18) by its finer sculpture on the early whorls.

The Matura specimens have about the same strength of the early sculpture as Recent shells. Their base is covered by five spirals which are crossed by lamellar growth lines. The second spiral from the periphery is stronger than the others. On all the Recent shells of *A. brevispina* available these spirals are nodose which is not the case on the Matura specimens.

Occurrence. — JS 67, RR 230, PJ 302, USGS 19860.

Genus **PARVITURBO** Pilsbry and McGinty

Pilsbry and McGinty, 1945, Nautilus, vol. 59, No. 2, p. 54.

Type species (by original designation), *Parviturbo rehderi* Pilsbry and McGinty.

Parviturbo maturensis, n. sp.

Pl. 42, figs. 14-17

Shell small, solid. Spire moderately depressed. Protoconch consists of a little more than one volution. Adult shell with $3\frac{1}{2}$ whorls. Sculpture consists of seven prominent spirals, the strongest one forming the periphery. Two spirals are situated between periphery and suture, the rest below the periphery. The lowest spiral borders the deep umbilicus. Spirals below the periphery less prominent. Interspaces crossed by faint, prosocline, axial threads. Aperture circular. Peristome thick. Parietal callus prominent.

Holotype. — Natural History Museum Basel, No. H 14625.

Dimensions of holotype. — Height 2.0 mm, diameter 2.9 mm.

Type locality. — Matura, Trinidad.

This species is based on the holotype and one immature paratype. The parietal callus of the holotype is broken. Although almost filled with matrix, the holotype seems to have a nacreous inner layer.

The genus *Parviturbo* is known to range only from Pliocene to Recent until now. *P. milium* (Dall) [1890-1903 (1892), p. 409, pl. 18, fig. 4; Olsson and Harbison, 1953, p. 349] from the Pliocene of Florida has a higher spire and does not show the prominent peripheral spiral. The same is true for the living Floridian *P. rehderi*, *P. francescae*, and *P. calidimaris*, all described by Pilsbry and McGinty (1945b, pp. 54-57). *P. venezuelensis* Weisbord (1962, p. 99, pl. 7, figs. 5-7), from the Pliocene Mare Formation of northern Venezuela, is based on a single, incomplete specimen which lacks the protoconch.

Occurrence. — PJ 302.

Family **NERITIDAE**Genus **NERITA** Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 776.

Type species (by subsequent designation, Montfort, 1810, *Conchyliologie systématique*, vol. 2, p. 347), *Nerita peloronta* Linné.

Subgenus **NERITA** s. str.**Nerita (Nerita) exuvioides** Trechmann ?

Pl. 42, figs. 12, 13

Shell large, thick. Spire low. Sculpture consists of 16 coarse,

flat-topped, spiral ridges with interspaces of about the same width. Spirals and interspaces crossed by fine, closely set, but prominent growth lines. Outer lip thick, with two coarse teeth above, six denticles and one large denticle below. Basal lip with two indistinct denticles. Inner lip with one denticle above, which continues into the aperture, one sharp and one rounded denticle below. Parietal callus with indications of rugae. Aperture semilunar.

This form is represented by a single specimen from the Melajo Clay. Its apex is worn, and part of the parietal callus broken. It is curious enough that it does not have two central teeth on the inner lip like similar Caribbean species of *Nerita s.str.*

N. exuvioides Trechmann (1935, p. 551, pl. 20, fig. 30) has originally been described from beds of questionable Pliocene age of Carriacou. Its type is an incomplete specimen. A reliable diagnosis must await the availability of well-preserved topotypes. *N. exuvioides* is said to have 12 spirals on the body whorl compared with 16 on the Melajo shell.

N. fulgurans Gmelin described by the writer (Jung, 1965, p. 479, pl. 62, fig. 14) from the middle Miocene of the Paraguaná Peninsula, Venezuela, is probably the same as the Melajo shell. It has also 16 spirals but is not so heavy, and has two central teeth on the inner lip, and some more denticles on the outer lip. The Recent *N. fulgurans* has about 20 spirals with much narrower interspaces than the fossils mentioned above.

Occurrence. — Hutch 51.

Genus **NERITINA** Lamarck

Lamarck, 1816, *Encycl. Méthodique, Vers.*, vol. 3, pl. 455; liste, p. 11.

Type species (by subsequent designation, Children, 1823, Lamarck's genera of shells, p. 111), *Nerita pulligera* Linné.

Subgenus **VITTA** Mörch

Mörch, 1852, *Catalogus conchyliorum* . . . Comes de Yoldi, pt. 1, p. 166.

Type species (by subsequent designation, Baker, 1923, *Acad. Nat. Sci. Philadelphia, Proc.*, vol. 75, p. 137), *Nerita virginea* Linné.

Neritina (*Vitta*) cf. *virginea* (Linné)

Pl. 43, figs. 1-3

Shell small. Spire somewhat elevated. Early whorls more convex than later ones. Body whorl slightly concave below suture.

Parietal callus moderately thick. Columellar lip with denticles. Growth lines, *i.e.* also the outer lip, proscoline. Color pattern consists of irregularly undulating, black lines which leave subcircular, white spots from time to time.

The above description is based on a complete specimen from the Melajo Clay. Specimens from the Courbaril beds and the Matura shell bed have the same color pattern and are thought to represent the same form. Most of them, however, are immature. An adult shell from Matura has an eroded spire and no colors preserved.

The adult shells at hand reach about the size of the Recent Caribbean *N. virginea*. Color patterns similar to that of the fossils are found on Recent specimens. The outer lip of the fossils under consideration is more oblique to the shell axis than in *N. virginea*.

Occurrence. — Melajo River area: Hutch 51, KR 11862, PJ 285, USGS 21178. Point Courbaril: K 8399, PJ 212, USGS 20432. Matura Bay: JS 67, RR 230, PJ 302, USGS 19860.

Family **RISSOINIDAE**

Genus **RISSOINA** d'Orbigny

D'Orbigny, 1840, Voyage dans l'Amerique Méridionale, vol. 5, (Mollusques), p. 395.

Type species (by monotypy), *Rissoina inca* d'Orbigny.

Subgenus **RISSOINA** s. str.

Rissoina (Rissoina) species

A single, probably not adult specimen (height 2.5 mm) from the Courbaril beds and two worn shells from Matura are available.

The protoconch of the Courbaril specimen is not entirely preserved but consisted of about three whorls. Postnuclear whorls five, sculptured by about 12 somewhat opisthocline axials. The strong axials which are aligned on successive whorls give a convex appearance to the whorls. Interspaces smooth. Outer lip thick. Parietal callus heavy.

The specimens at hand are similar to the Recent Caribbean *R. fischeri* Desjardin (1949, p. 199, pl. 9, fig. 6; Warmke and Abbott, 1961, p. 56, pl. 10 n), but more material is needed to point out affinities.

Occurrence. — Point Courbaril: K 1429. Matura Bay: PJ 302.

Family **VITRINELLIDAE**Genus **TEINOSTOMA** H. and A. Adams

Adams, H. and A., 1853, Genera of Recent Mollusca, vol. 1, p. 122.

Type species (by subsequent designation, Adams, A., 1863, *Thesaurus conchyliorum*, pt. 22, p. 259), *Teinostoma politum*. A. Adams..

Subgenus **PSEUDOROTELLA** Fischer

Fischer, 1857, Jour. de Conchyl., vol. 6, p. 52.

Type species (by monotypy), *Rotella semistriata* d'Orbigny.

Teinostoma (Pseudorotella) nugax, n. sp. Pl. 43, figs. 7-9

Shell small, with about $3\frac{1}{2}$ whorls, entirely smooth except for faint growth lines. Spire low. Periphery rounded. Suture usually distinct but sometimes partly covered by succeeding whorl. Umbilicus covered by callus, its border more or less distinct. Peristome thin. Parietal callus separated from umbilical callus by a faint groove.

Holotype. — Natural History Museum Basel, No. H 14599.

Dimensions of holotype. — Height 0.6 mm, diameter 1.6 mm.

Type locality. — Melajo River area: KR 11862.

This species is represented by numerous specimens from the Melajo Clay. The thickness of the umbilical callus undergoes some variability. The margin of the umbilical callus and the groove between it and the parietal callus may be obscure.

T. nugax differs in details of the umbilical callus and the convexity of the whorls from the following three Pliocene species: *T. antilleanum* Weisbord (1962, p. 131, pl. 12, figs. 7-9) from northern Venezuela, *T. avunculus* Pilsbry (in Olsson and Harbison, 1953, p. 413, pl. 49, figs. 3-3d) from Florida, and *T. ecuadorianum* Pilsbry and Olsson (1941, p. 47, pl. 9, fig. 1) from Ecuador. *T. ecuadorianum* has also been recorded from the Recent fauna of Peru.

Occurrence. — EL 1810, KR 11862, PJ 285, USGS 18399.

Teinostoma (Pseudorotella) spretum, n. sp. Pl. 43, figs. 4-6

Shell small, with about $3\frac{1}{2}$ whorls. Surface smooth except for faint growth lines. Spire relatively high. Whorls convex. Suture incised. Aperture almost circular. Peristome solid. Parietal callus small. Umbilicus entirely covered by a smooth callus which may be

bordered by an obscure line. Parietal callus separated from umbilical callus by a groove.

Holotype. — Natural History Museum Basel, No. H 14607.

Dimensions of holotype. — Height 1.5 mm, diameter 2.3 mm.

Type locality. — Melajo River area: KR 11862.

This species is not abundant. The umbilicus of immature specimens is not entirely covered by callus. On some shells one, two or even three faint spirals may be developed at the beginning of the last whorl which, however, disappear after half a volution. The uppermost of these spirals forms the periphery.

The type and only specimen of *T. caronense* Mansfield (1925, p. 60, pl. 8, figs. 9, 11), from the Brasso Formation of Trinidad, has a heavier shell and a less elevated spire than *T. spretum*. Although apparently worn it shows faint spiral sculpture.

T. spretum has dimensions and proportions similar to *T. pycnum* (Woodring) (1928, p. 446, pl. 38, figs. 10-12) from the Bowden Formation of Jamaica, but *T. pycnum* has a thicker shell and differs in details of the callus. *T. vitreum* (Gabb) (1873b, p. 243; Pilsbry, 1922, p. 399, pl. 37, figs. 3-3b) from the Cercado Formation of the Dominican Republic mainly differs by the shape of its umbilical callus. *T. altum* Pilsbry (in Olsson and Harbison, 1953, p. 413, pl. 49, figs. 2-2f) from the Pliocene of Florida has the same type of spire, but its umbilicus is not entirely closed even in the adult stage.

Occurrence. — KR 11862, PJ 285, USGS 18399.

Subgenus **AEPYSTOMA** Woodring

Woodring, 1957, U. S. Geol. Sur. Prof. Paper 306-A, p. 70.

Type species (by original designation), *Teinostoma (Aepystoma) andrium* Woodring.

Teinostoma (Aepystoma) caroniense Maury Pl. 43, figs. 10-17

1925. *Teinostoma caroniense* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 249, pl. 43, figs. 3, 4.

1938. *Teinostoma (Pseudorotella ?) caroniense* Maury, Vokes, Amer. Museum Novitates, No. 988, p. 5.

1942. *Solariorbis ? nov. sp. ind.*, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 127, pl. 4, figs. 4, 5.

Shell solid. Spire depressed. Protoconch with a little more than two volutions. Postnuclear whorls a little less than two. Peri-

phery rounded. Suture clearly incised. Sculpture consists of prosocyrty growth lines. On the third volution these are crossed by obscurely punctate spiral striae producing a cancellate pattern below the periphery. Peristome solid. Umbilical and parietal callus not separated by a groove.

Lectotype (herewith selected). — Paleont. Research Inst., Ithaca, N.Y., No. 1105 (specimen figured by Maury, 1925, pl. 43, fig. 3).

Dimensions of lectotype. — Height 2.0 mm, diameter 4.5 mm.

Type locality. — Springvale Quarry, Trinidad.

This species is represented from the Melajo Clay and the Courbaril beds by specimens of different ontogenetic stages showing that immature shells look entirely different than adult ones. Young specimens have an open umbilicus, and their third whorl is sculptured by punctate spirals which are usually more conspicuous below the periphery. Adults have a closed umbilicus and a smooth base. The sculpture of the earlier stages is visible only on the spire. The body whorl may be somewhat shouldered.

Topotypes of *T. caroniense* at hand are too much worn to show the sculpture on the third whorl. *Solariorbis* ? n. sp. ind. described and figured by Rutsch from Springvale Quarry represents immature *T. caroniense*.

T. andrium Woodring (1957 p. 70, pl. 17, figs. 40-42, pl. 18, figs. 9-11) from the Gatun Formation of Panama is a similar species differing only by its thicker parietal callus and the somewhat more convex upper part of the body whorl.

Occurrence. — Melajo River area: EL 1810, KR 11862, K 9903, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, PJ 212, USGS 10991, USGS 20433, USGS 20434.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm. Courbaril beds of Upper Morne l'Enfer Fm.

***Teinostoma (Aepystoma) melajoense*, n. sp.**

Pl. 43, figs. 18-20

Shell small, solid. Protoconch with $2\frac{1}{4}$ smooth volutions; post-nuclear whorls a little less than two. Spire somewhat elevated, whorls convex. Suture clearly incised. Periphery broadly rounded. Sculpture consists of numerous spirals which are somewhat broader and more conspicuous on base. Umbilicus open in immature specimens. Umbilical callus small, but closing umbilicus in adults.

Peristome solid. Parietal callus thick, not clearly separated from umbilical callus.

Holotype. — Natural History Museum Basel, No. H 14611.

Dimensions of holotype. — Height 1.8 mm, diameter 2.4 mm.

Type locality. — Melajo River area: PJ 285.

This species is represented by 10 specimens. *T. caronense* Mansfield (1925, p. 60, pl. 8, figs. 9, 11), from the Brasso Formation of Trinidad, is based on a single specimen (USNM 352690). It is closely related to *T. melajoense*. However, it is worn, and its spiral sculpture is hardly recognizable. Topotypes of *T. caronense* are needed for useful comparison.

T. melajoense differs from *T. caroniense* Maury by its higher spire and by its proportionately higher whorls. The aperture of *T. caroniense* is obliquely elongate but subcircular in *T. melajoense*. Moreover the body whorl of *T. caroniense* is smooth but carries spiral sculpture in *T. melajoense*.

The Recent *T. clavium* Pilsbry and McGinty (1945a, p. 4, pl. 1, fig. 1) from Florida has a lower spire. *T. pilsbryi* McGinty (1945, p. 142; Pilsbry and McGinty, 1945a, p. 3, pl. 1, fig. 5), also a Recent Floridian species, has a spire like *T. melajoense*, but its periphery is somewhat angulated and the umbilical callus much heavier.

Occurrence. — EL 1810, KR 11862, PJ 285, USGS 18399, USGS 21178.

Genus **COCHLIOLEPIS** Stimpson

Stimpson, 1858, Boston Soc. Nat. Hist., Proc., vol. 6, p. 307.

Type species (by monotypy), *Cochliolepis parasitica* Stimpson.

Cochliolepis pluscula, n. sp.

Pl. 43, figs. 21-23

Small, thin-shelled, with about three whorls. Spire not elevated. Suture sharply incised. Whorls moderately convex, smooth except faint, slightly prosocyrta growth lines. Periphery evenly rounded. Umbilicus open. Aperture almost circular, angulated above. Peristome thin. Parietal callus conspicuous but translucent.

Holotype. — Natural History Museum Basel, No. H 14617.

Dimensions of holotype. — Height 0.8 mm, diameter 1.6 mm.

Type locality. — Melajo River area: PJ 285.

This species is represented from the Melajo Clay by the holo-

type and four paratypes, all perfectly preserved. It seems most closely related to *Delphinula lipara* H. C. Lea (1846, p. 261, pl. 36, fig. 71) from the Miocene of Virginia, the holotype of which has been refigured by Gardner [1943-1948 (1948), pl. 25, figs. 6-8]. *D. lipara* has more whorls, and its body whorl is somewhat shouldered. The Miocene *C. virginica* Pilsbry (in Olsson and Harbison, 1953, p. 434, pl. 52, figs. 4, 4a, 4b) from Virginia, for which Pilsbry proposed the subgeneric name *Tylaxis*, is much larger, and has an obliquely oval aperture.

Occurrence. — PJ 285, USGS 18399.

Genus **CYCLOSTREMISCUS** Pilsbry and Olsson

Pilsbry and Olsson, 1945, Acad. Nat. Sci. Philadelphia, Proc., vol. 97, p. 266.

Type species (by original designation), *Vitrinella panamensis* C. B. Adams.

Subgenus **PONOCYCLUS** Pilsbry

Pilsbry, 1953, Acad. Nat. Sci. Philadelphia, Mon., No. 8, p. 426.

Type species (by original designation), *Adcorbis beauui* Fischer.

Cyclostremiscus (Ponocyclus) pentagonus (Gabb) Pl. 43, figs. 24-26

1873. *Cyclostrema pentagona* Gabb, Amer. Philos. Soc., Trans., new ser., vol. 15, p. 243.

1881. *Vitrinella pentagona* (Gabb), Gabb, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 8, p. 368, pl. 47, fig. 68.

1957. *Cyclostremiscus (Ponocyclus) pentagonus* (Gabb), Woodring, U.S. Geol. Sur., Prof. Paper 306-A, p. 73, pl. 17, figs. 7-15. For further citations see this publication.

Shell small, with a little more than four whorls. Spire depressed. First $2\frac{1}{2}$ volutions smooth. Later whorls with three carinae of about equal strength. The uppermost carina appears at the end of the third volution, the middle one forms the periphery, and corresponds to the position of the suture on earlier whorls. The lowest one forms a strong angulation on the base. Umbilical wall of last whorl with four spirals. Aperture almost circular, angulated above. Parietal callus inconspicuous.

Type. — Acad. Nat. Sci. Philadelphia, No. 2831.

Type locality. — Dominican Republic (Miocene).

C. pentagonus is frequent in the Melajo Clay. The morphological features of the Melajo specimens are constant. There are no bicarinate shells, and the carinae are constant in strength. The

spirals on the umbilical wall of the last whorl are always present and not variable as pointed out by Pilsbry (*in* Olsson and Harbison, 1953, p. 429) for the Pliocene to Recent *C. trilix* (Bush) (1885, p. 464, pl. 45, figs. 7, 7a). Pilsbry separated *C. trilix* from *C. pentagonus* because of its larger size (diameter from 3 mm to 3.8 mm). The Melajo specimens do not grow larger than 2.5 mm in diameter.

Woodring (1957, p. 74) has discussed some related species from the Pleistocene and Recent faunas of the West Coast of America. Gardner [1926-1950 (1947), p. 600] recorded *C. trilix* from the Chipola and Shoal River Formations of Florida, but did not figure it. According to Woodring these specimens are larger than those from the Gatun Formation.

Occurrence. — EL 1810, KR 11862, PJ 285, USGS 18399, USGS 21178.

Distribution. — Middle to upper Miocene: Cercado and Gurabo Fms., Dominican Republic. Bowden Fm., Jamaica. Gatun Fm., Panama Canal Zone. Melajo Clay Member of Springvale Fm., Trinidad.

Cyclostremiscus (Ponocyclus) species

From the Matura shell bed a single, worn specimen (H 14623) is at hand. It is partly broken and has almost four whorls. The spirals on the umbilical wall are not recognizable. It looks like the Melajo specimens of *C. pentagonus*, but a definite determination is not possible. Diameter 2.0 mm.

Occurrence. — PJ 302.

Genus SOLARIORBIS Conrad

Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 30.

Type species (by subsequent designation, Dall, 1892, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 2, p. 414), *Delphinula depressa* Lea.

Solariorbis (subgenus ?) marginatus (Guppy) Pl. 43, figs. 27-29

1867. *Vitrinella marginata* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 161, 173; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 40, 52.

1874. *Vitrinella marginata* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 435, 441, pl. 18, figs. 21a, 21b.

Shell small, spire depressed. Protoconch with two smooth volu-

tions; postnuclear whorls a little less than one and a half. First sculpture consisting of faint prosocline axials which disappear after a little less than one revolution. Body whorl sculptured by a few faint spirals just above the periphery. Periphery formed by a strong carina. Just below it follow a second carina of equal strength and a third weaker one. Interspace between middle and peripheral carinae deeply concave. Umbilicus wide. Aperture slightly obliquely oval. Basal lip somewhat everted. Parietal callus moderately prominent.

Type. — A collection of Tertiary fossils from the West Indies which included Guppy's types has been purchased by the U. S. National Museum in 1894. As it does not contain *S. marginatus*, the type of that species seems to be lost. The proper specimen to be selected for a neotype would be: Natural History Museum Basel, No. H 15345.

Dimensions of specimen Nat. Hist. Mus. Basel, No. 15345. — Height 0.8 mm, diameter 1.6 mm.

Type locality. — Matura Bay.

This species is exceedingly rare at Matura. A single specimen from the Melajo Clay is tentatively identified as *S. marginatus*. It is somewhat worn and differs from Matura specimens in having more inflated whorls.

The subgeneric assignment of *S. marginatus* is somewhat uncertain. It is intermediate between *Hapalorbis* Woodring (1957, p. 75; type species by original designation: *Circulus liriopae* Bartsch) and *Systellomphalus* Pilsbry and Olsson (1941, p. 48; type species by original designation: *Systellomphalus perornatus* Pilsbry and Olsson). *S. marginatus* is clearly separated from *Hapalorbis* by the presence of axials on the spire. From the type species of *Systellomphalus* it differs by the absence of axial wrinkles on the base near the umbilicus.

The Recent *S. liriopae* Bartsch (1911, p. 231, pl. 40, figs. 7-9), from the Gulf of California, and *S. hyptius anebus* Woodring (1957, p. 75, pl. 17, figs. 34-36), from the middle Miocene Gatun Formation of the Panama Canal Zone, have a prominent spiral above the periphery. This spiral is lacking in *S. marginatus* as well as in the Recent Panamic *S. seminudus* (C. B. Adams) (1852, p. 412; Pils-

bry and Olsson, 1945, pl. 27, figs. 3, 3a, 3b). However, *S. seminudus* has wrinkles around the umbilicus.

S. marginatus seems to be more closely related to *Systellomphalus* as there are species assigned to that subgenus which do not have radial wrinkles on the base. The Recent *S. euzonus* Pilsbry and McGinty (1950, p. 85, pl. 5, figs. 7, 7a) from Florida is proportionately higher, and the spirals above the periphery are more conspicuous. *S. euzonus* has also been recorded from the Pliocene of Florida by Pilsbry (in Olsson and Harbison, 1953, p. 420, pl. 56, figs. 2, 2a, 2b).

Occurrence. — Melajo River area: KR 11862 (?). Matura Bay: PJ 302, USGS 19860.

Distribution. — Melajo Clay Member of Springvale Fm. (?). Matura shell bed.

Family CAECIDAE

The Caecidae are not only poorly represented in the three faunas under consideration, but there are also no complete specimens. For this reason it seems advisable not to name these species.

Genus CAECUM Fleming

Fleming, 1813, Brewster's Edinburgh Encyclopaedia, vol. 7, p. 67 (see Sherborn, Index Animalium, 1801-50, pt. 5, p. 950, 1924).

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 203), *Dentalium trachea* Montagu.

Collins (1937) described the three growth stages of Mexican Tertiary caecids. Due to scarcity of material no attempt is made to assign the forms listed below to subgenera. Three species occur in the Melajo Clay, one in the Courbaril beds, and one at Matura.

Caecum species A

Protoconch with two planispiral volutions. The second stage consists of a weakly arched but rapidly enlarging tube. It is ornamented by annular rings with interspaces of about the same width. Length (including protoconch) 0.8 mm diameter 0.2 mm.

The specimens referred to this form are immature. They do not show a constriction toward the aperture. *C. properegulare* Mansfield (1925, p. 50, pl. 8, fig. 6), although collected from a float, probably came out of the Brasso Formation of Trinidad. It is larger and has coarser annular rings than *Caecum* species A.

Occurrence. — Melajo River area: USGS 18399.

Caecum species B

A few immature specimens represent the second stage. They are relatively strongly curved, smooth, and circular in cross section. Apical opening closed by a convex, somewhat projecting plug. Length 0.8 mm, diameter 0.2 mm.

Occurrence. — Melajo River area: USGS 18399.

Caecum species C

A few specimens probably representing the third stage are smooth except for growth lines. The apical opening is closed by a convex, somewhat projecting plug. They are much less curved than *Caecum* species B, and have a much larger diameter than either *Caecum* species A or *Caecum* species B. Length 1.5 mm, diameter 0.6 mm.

Occurrence. — Melajo River area: USGS 18399.

Caecum species D

Two specimens from the Courbaril beds are ornamented by annular rings with wider interspaces. Length 1.3 mm, diameter 0.3 mm.

This form is close to the upper Miocene to Recent *C. regulare* Carpenter (Zool. Soc. London, Proc., vol. 26, p. 428, 1858; Weisbord, 1962, p. 162, pl. 14, figs. 10, 11) but has finer annular rings.

Occurrence. — Point Courbaril: USGS 10991.

Caecum species E

Some specimens from Matura are entirely smooth. The tube does not show the thickening which is typical for *Meioceras*. Length 2.2 mm, diameter 0.4 mm.

Occurrence. — Matura Bay: RR 230, USGS 19860.

Family TURRITELLIDAE**Genus TURRITELLA** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 74.

Type species (by monotypy), *Turbo terebra* Linné.

Subgenus BRODERIPTELLA Olsson

Olsson, 1964, Neogene Mollusks from Northwestern Ecuador, Paleont. Research Inst., p. 188.

Type species (by original designation), *Turritella broderipiana* d'Orbigny.

***Turritella (Broderiptella) bifastigata cartagenensis* Pilsbry and Brown**
Pl. 44, figs. 1-4

1917. *Turritella cartagenensis* Pilsbry and Brown, Acad. Nat. Sci. Philadelphia, Proc., vol. 69, p. 34, pl. 5, fig. 13.
 1925. *Turritella cartagenensis* Pilsbry and Brown, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 233, pl. 42, fig. 13.
 1926. *Turritella bifastigata maracaibensis* Hodson, Bull. Amer. Paleont., vol. 11, No. 45, p. 48, pl. 30, figs. 2, 4, 6.
 1926. *Turritella bifastigata democraciana* Hodson, *ibidem*, p. 50, pl. 29, fig. 3, pl. 30, figs. 3, 5.
 1929. *Turritella cartagenensis* Brown and Pilsbry, Weisbord, Bull. Amer. Paleont., vol. 14, No. 54, p. 30, pl. 9, figs. 1, 2.
 1941. *Turritella* cf. *cartagenensis* Pilsbry and Brown, Merriam, Univ. Cal. Publ., Bull. Dept. Geol. Sci., vol. 26, No. 1, p. 207, pl. 38, fig. 9.

Of medium size. First sculpture consists of a medial spiral keel (mesocostate) and a smaller spiral at the lower suture. Additional minor spirals of varying size are first introduced on the lower half of the whorl, then on the upper half. With increasing age the medial primary spiral gradually loses its prominence until it is of the same size as the others. Adult whorls are slightly concave to almost straight in profile. In the gerontic stage the whorls are less tightly coiled, and their periphery is rounded. Base covered by numerous fine spirals. Growth lines prosocline on upper part of whorl, turning toward an orthocline direction on middle part of whorl, and running straight across the periphery to the columella.

Holotype. — Acad. Nat. Sci. Philadelphia.

Type locality. — Near Cartagena, Colombia (Miocene).

This species is represented from the Melajo Clay and the Courbaril beds. Most specimens from the Courbaril beds are strongly rolled, and their spiral sculpture has mostly disappeared. The Melajo specimens may attain a considerable size, when they reach the gerontic stage. No complete specimen including the protoconch is preserved in the material at hand.

As suggested by Woodring (1957, p. 111) Hodson's *T. bifastigata maracaibensis* and *T. bifastigata democraciana* seem to be conspecific with *T. cartagenensis*. The lectotype of *T. bifastigata* Nelson (1870, p. 189) has been figured by Hodson (1926, pl. 30, fig. 1). The sculpture of its base is much coarser, its whorls more concave, and the spiral sculpture weaker than in *T. cartagenensis*.

T. oreodoxa Olsson (1922, p. 152, pl. 14, fig. 1), from the Miocene of Costa Rica, and *T. cartagenensis* have been taken in the synonymy of *T. bifastigata* by Olsson (1964, p. 189).

Occurrence. — Melajo River area: Hutch 51, K 9813, K 9903, RR 290, USGS 18399. Point Courbaril: K 8399, K 12013, K 12255, RR 120, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 20433, USGS 20434, USGS 21778.

Distribution. — Miocene of Colombia. Beds of questionable upper Miocene age, Usiacuri region, Colombia. Miocene, Falcón, Venezuela. Trinidad: Manzanilla Fm. (Maury), Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm..

Turritella (Broderiptella) aff. mimetes Brown and Pilsbry Pl. 44, fig. 5

Of medium size. Early sculpture consists of a medial spiral, another spiral at the lower suture, and a third one between them. The medial spiral forms a moderately prominent carina. On the next volutions additional minor spirals appear on the lower and upper halves of the whorl. The strength of the medial spiral diminishes compared with the other spirals but is still well discernible in the adult stage. The spiral at the lower suture becomes the most prominent one, and forms a carina-like periphery in the adult stage. After about nine whorls the apical angle becomes somewhat smaller. Base sculptured by a few spirals with many fine spirals in their interspaces. Growth lines prosocline on upper part of whorl, turning in an almost orthocline direction below.

This form occurs in the Melajo Clay only. One of its most conspicuous features is the change of the apical angle after about nine whorls. Some specimens develop a real carina in the adult stage. The early whorls are almost like those of *T. cf. broderipiana* as figured by Merriam (1941, pl. 36, fig. 1).

T. mimetes Brown and Pilsbry (1911, p. 357, pl. 27, fig. 1), from the Gatun Formation of the Panama Canal Zone, has been redescribed and its allies discussed by Woodring (1957, p. 110, pl. 22, figs. 6-9). The early sculptured whorls of *T. mimetes* are more rounded in profile, and the spiral at the lower suture does not become as prominent as in the present form.

Occurrence. — EL 1810, Hutch 51, K 9816, RR 290, PJ 285, USGS 18399, USGS 21178.

Turritella (Broderiptella) planigyrate Guppy Pl. 45, figs. 1, 2

1867. *Turritella planigyrate* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 169; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 35, 48.

1873. Not *Turritella planigyrate* Guppy, Gabb, Amer. Philos. Soc., Trans., new ser., vol. 15, p. 240.
1874. *Turritella planigyrate* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 408, 437, pl. 18, fig. 5.
1876. Not *Turritella planigyrate* Guppy, Guppy, Quart. Journ. Geol. Soc. London, vol. 32, p. 519.
1910. *Turritella* (sic) *planigyrate* Guppy, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, pp. 5, 11; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 148, 153.
1917. Not *Turritella planigyrate* Guppy, Maury, Bull. Amer. Paleont., vol. 5, No. 29, p. 129, pl. 22, fig. 14 (= *T. mauryae* Hodson).
1925. *Turritella planigyrate* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 232, pl. 42, figs. 6, 7, 8.
1925. *Turritella planigyrate* Guppy, Mansfield, U.S. Nat. Mus., Proc., vol. 66, art. 22, p. 55, pl. 9, figs. 1, 9.
1926. *Turritella planigyrate* Guppy, Hodson, Bull. Amer. Paleont., vol. 11, No. 45, p. 29, pl. 19, figs. 2, 9.
1938. *Turritella planigyrate* Guppy, Vokes, Amer. Museum Novitates, No. 988, p. 4.
1942. *Turritella planigyrate* Guppy, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 131, pl. 8, fig. 5.

Of small to medium size. Protoconch with about two volutions. First sculpture consists of a medial spiral (mesocostate) forming a carina, and a minor spiral a little below it. After one volution a third spiral appears at the lower suture. Subsequently additional fine spirals are intercalated all over the whorl. The medial carina remains prominent for about eight whorls, but afterwards it becomes less prominent until it is of almost the same size as the other spirals. The whorls remain somewhat convex even in the adult stage. The adult whorls are covered by closely set, subequal spirals, mostly alternating with still finer ones. Base sculptured by numerous spirals, some of them a little more prominent. Growth lines prosocline on upper part of whorl, turning in an orthocline direction on the middle part, and running from there straight down across the periphery to the columella.

Holotype. — USNM 115452. This lot contains only one rather worn specimen. Guppy collected it from the Caroni Series at Savanetta which is the only locality he indicated in the original description. It is thus the holotype.

Another lot (USNM 115626) labelled "types" and mentioned by Mansfield (1925, p. 56) has been collected by Guppy at a locality (Montserrat) not mentioned in the original description. Apparently this lot is no longer in the collections of the U. S. National Museum.

Type locality. — Guppy's Savanetta which is the same as the locality Brechin Castle Estate referred to by Rutsch (1942, p. 105, fig. 1).

T. planigyrate is frequent in the Melajo Clay. The spirals of the Melajo specimens are usually less uniform in size than those of specimens from the type area. The medial spiral of Springvale specimens is mostly not more prominent than the others on adult whorls.

The separation of *T. aff. mimetes* from *T. planigyrate* may seem artificial. Their early stages and their growth lines are the same, but the sculpture on later whorls is much coarser and less regular in *T. aff. mimetes*.

T. planigyrate has a larger apical angle than *T. maiquetiana* Weisbord (1962, p. 146, pl. 11, figs. 1-16) from the Pliocene Marc Formation of northern Venezuela. *T. maiquetiana* has a rounded periphery on the late adult to gerontic whorls, whereas in *T. planigyrate* it is angulated at the same stage.

Occurrence. — EL 1810, Hutch 47, Hutch 51, KR 11862, K 9816, K 9903, PJ 285, USGS 18399, USGS 18411, USGS 18634, USGS 21178.

Distribution. — Miocene, eastern Venezuela. Trinidad: Manzanilla Fm. (?), Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm.

Turritella (Broderiptella) aff. planigyrate Guppy Pl. 45, figs. 4-6

Of medium size. First sculpture consists of a medial spiral which forms a carina, a second spiral at the lower suture, and a third minor one between them. The medial carina gradually disappears, whereas the spiral at the lower suture remains more prominent than the others, and may form an overhanging carina on adult whorls. Already in early stages numerous additional spirals are intercalated all over the whorl. These usually alternate in size subsequently. But on adult whorls there are mostly five or six more prominent spirals with interspaces covered by minor spirals. Base sculptured by numerous spirals; a few near the periphery are more prominent.

This form which occurs at Matura evidently is intermediate between *T. planigyrate* and the Recent Caribbean *T. variegata*

(Linné). It differs from *T. planigyrate* by its less uniform sculpture on adult whorls and its more conspicuous lowest spiral. This lowest spiral is frequently accentuated in *T. variegata*. *T. variegata* may have a few more conspicuous spirals on adult whorls like *T. aff. planigyrate*, but the periphery of its late whorls is rounded which is never the case in the Matura specimens. On the early whorls of *T. variegata* the spirals above the medial carina appear before those below, whereas in *T. aff. planigyrate* the lower ones appear first.

Occurrence. — RR 230, PJ 302, USGS 18204, USGS 19860.

Subgenus **BACTROSPIRA** Cossmann

Cossmann, 1912, *Essais de Paléoconchologie comparée*, neuvième livraison, p. 129.

Type species (by original designation), *Turritella perattenuata* Heilprin.

Turritella (Bactrospira) species

Pl. 45, fig. 3

A single, strongly worn fragment from Matura is at hand. It consists of three whorls, and is slender. It is sculptured by two broad spirals with a wide, concave interspace.

This fragment is related with the group of *T. altilira* Conrad. *T. altilira* has been rediscussed by Woodring (1957, p. 102, pl. 23, figs. 1, 7, 12, 13) and Olsson (1964, p. 193, pl. 36, figs. 2-2b). The specimen at hand is more closely related to *T. altilira* and to *T. perattenuata* Heilprin (1887, p. 88, pl. 8, fig. 13; Olsson and Harbison, 1953, p. 316, pl. 44, figs. 4-4c) from the Pliocene of Florida, the type species of *Bactrospira*, than to the Recent *T. exoleta* (Linné), the type species of *Torcula*. *T. exoleta* is a more fragile species than the Matura shell and has a larger apical angle.

Occurrence. — RR 230.

Genus **SPRINGVALEIA** Rutsch

Rutsch, 1942, *Verh. Naturf. Ges. Basel*, vol. 54, p. 133.

Type species (by original designation), *Scalaria leroyi* Guppy.

Springvaleia leroyi (Guppy)

1867. *Scalaria leroyi* Guppy, *Proc. Sci. Assoc. Trinidad*, pt. 3, pp. 155, 168; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, pp. 34, 47.

1958. *Springvaleia leroyi* (Guppy), Woodring, *Bull. Amer. Paleont.*, vol. 38, No. 169, p. 166, pl. 17, figs. 1-5. For additional citations see this publication.

Type. — Rutsch (1942, p. 134) selected the specimen figured by Maury (1925, pl. 41, fig. 11) as neotype (Paleont. Research Inst., Ithaca, N.Y., No. 1087). This neotype, however, was not collected at the type locality but at Springvale Quarry. Woodring (1958, p. 167), therefore, designated another neotype: the specimen figured by Rutsch (1942, pl. 7, figs. 1a, 1b). Unfortunately this second neotype (Natural History Museum Basel, No. H 6146) is not a virtual topotype of *Scalaria leroyi*, i.e. it was not collected at the locality Brechin Castle Estate referred to by Rutsch (1942, p. 105, fig. 1) as stated by Woodring but at Springvale Quarry like the neotype designated by Rutsch.

The search for satisfactory specimens from Guppy's Savonetta [*sic*] area in the U.S. National Museum and the Natural History Museum Basel was not successful. Mr. D. L. F. Sealy informed me that there are no specimens at all from that area in the British Museum (Natural History). Rutsch's designation of the neotype, therefore, has to be validated until satisfactory topotypes of *Scalaria leroyi* are available.

Locality of neotype. — Springvale Quarry, Trinidad.

This species has been discussed by Woodring (1958). It is represented by two specimens from the base of the Melajo Clay. One of them has been illustrated by Woodring (1958, pl. 17, figs. 2-5). Protoconch and early stages of *S. leroyi* are still unknown.

Weisbord (1962, p. 150, pl. 12, figs. 2-6) described *S. leroyi secunda* from the Pliocene Mare Formation of the Cabo Blanco area, Venezuela. It differs from *S. leroyi* by its less inflated whorls, and the presence of lirations within the aperture. These differences are confirmed by specimens from the type area of *S. leroyi secunda* in the collections of the Natural History Museum Basel.

Occurrence. — USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Genus **VERMICULARIA** Lamarek

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 78.

Type species (by monotypy), *Serpula lumbricalis* Linné.

According to Morton (1953, p. 86) the genus *Vermicularia* is close to *Turritella* in many respects and should probably be placed

in the Turritellidae. On the other hand Olsson and Harbison (1953, p. 306) used the family heading Vermiculariidae.

Vermicularia spirata (Philippi) ?

Pl. 44, fig. 11

1864. *Vermetus royanus* d'Orbigny, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35 (part); reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.
 1864. *Vermetus lumbricalis* Linné, Guppy, *ibidem*, p. 35; reprint, Harris, 1921, *ibidem*, p. 15.
 1867. *Vermetus lumbricalis* Linné, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 156; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 35.
 1874. *Vermetus lumbricalis* Linné, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 437.
 1925. *Vermicularia spirata* var. *trilineata* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 228, pl. 41, fig. 6.
 1925. *Vermicularia* cf. *radicula* Stimpson, Maury, *ibidem*, p. 228, pl. 41, fig. 1.

This form is represented from Matura by numerous, mostly small specimens. Fully grown shells with a long, irregularly coiled tube are lacking. The *Turritella* stage consists of about seven whorls. Their early sculpture consists of two primary spirals, the lower one usually being stronger, and a third spiral at the lower suture. The uppermost one of these spirals may be very weak.

Olsson and Harbison considered the Matura *Vermicularia* to be the same as what they described as *V. woodringi* (1953, p. 307, pl. 47, fig. 2) from the Pliocene of St. Petersburg, Florida. They also included in the synonymy of *V. woodringi* the *Vermicularia* occurring in the Bowden Formation of Jamaica which had been described as *V. spirata* by Woodring (1928, p. 344, pl. 26, fig. 5). Bowden specimens may have one or two primary spirals on the whorls of the *Turritella* stage.

Among the Recent material of *V. spirata* (Philippi) (Archiv f. Naturg., p. 224, pl. 7, figs. 1, a, b, c, 1836) shells with one prominent spiral in the *Turritella* stage are predominant. However, there are lots containing specimens with one or two spirals. A definite identification of the Matura fossils must wait until the variability of the Recent *V. spirata* is known.

Specimens from the Pliocene of Moín near Puerto Limón, Costa Rica, have one spiral but tend to have a shorter *Turritella* stage than the Recent *V. spirata*.

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Vermicularia (?) trilineata (Guppy)

Pl. 44, figs. 6-10

1864. *Vermetus royanus* d'Orbigny, Guppy (part), Trans. Sci. Assoc. Trinidad

- for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.
1867. *Vermetus trilineatus* Guppy (part), Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 170; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 35, 49.
1874. *Vermetus trilineatus* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 408, 437, pl. 18, fig. 12.
1925. Not *Vermicularia spirata* var. *trilineata* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 228, pl. 41, fig. 6.

Shell small, slender. Protoconch consists of a little more than one volution. First sculpture with a medial spiral forming a carina. After less than one whorl a second spiral at the lower suture, and a third one a little distance from the upper suture appear. The medial carina gradually diminishes in strength until the whorl profile is straight.

Lectotype (herewith selected). — USNM 115455.

Dimensions of lectotype. — Height 12.0 mm, diameter 2.1 mm.

Type locality. — Matura, Trinidad.

The original type lot of *Vermetus trilineatus* consisted of six specimens. As pointed out by Woodring (1928, p. 345) it includes two species. Four specimens represent *V. (?) trilineata*, the largest one being the lectotype.

Despite of additional material from Matura there is no proof whether this species belongs to *Turritella* or *Vermicularia*, because it does not contain adult specimens showing all growth stages. The lectotype is slender, its whorls flat (but slight inflation of the whorls may occur as well), and there are no traces of uncoiling. Other specimens, however, with the same type of sculpture and suggestion of about the same apical angle, show the beginning of uncoiling. If *V. (?) trilineata* really is a *Vermicularia*, then it has a long *Turritella* stage.

If this species proves to be a *Turritella*, it will need a new name as *trilineata* is preoccupied by *Turritella trilineata* Smith (Strat. Syst. org. foss., p. 8, 1817; see Sherborn, Index Animalium, pt. 27, p. 6612, 1931).

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

Family VERMETIDAE

Genus SERPULORBIS Sassi

Sassi, 1827, Giornale Ligustico di Scienze, Lettere ed Arti, pt. 5, p. 483.

Type species (by monotypy), *Serpulorbis polyphragma* Sassi (= *Serpula arenaria* Linné).

Serpulorbis decussatus (Gmelin)

Pl. 43, figs. 30, 31

1791. *Serpula decussata* Gmelin, Systema Naturae, ed. 13, vol. 1, pt. 6, p. 3745.
 1864. *Siphonium decussatum* Gmelin, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.
 1867. *Siphonium decussatum* Gmelin, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 156; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 35.
 1874. *Siphonium decussatum* Gmelin, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 438.
 1925. *Serpulorbis decussata* Gmelin, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 224, pl. 41, fig. 3.
 1953. *Lemintina decussata* (Gmelin), Olsson and Harbinson, Acad. Nat. Sci. Philadelphia, Mon. No. 8, p. 305, pl. 46, figs. 3-3c.

This species occurs at Matura and in the Courbaril beds. A small specimen from the Courbaril beds shows part of its protoconch which has about three smooth volutions. The early sculpture consists of prominent longitudinal ribs with wide interspaces which are crossed by much finer and closely set concentrics. Beads are formed at the intersections. Subsequently additional longitudinal ribs are intercalated, and at the same time the concentrics greatly diminish in strength. Later stages also have tertiary longitudinal ribs which are indistinctly beaded but no concentrics.

S. decussatus and *S. papulosus* (Guppy) (1866a, p. 292, pl. 17, fig. 3; Woodring, 1928, p. 346, pl. 26, fig. 6) originally described from Bowden, Jamaica, both occur in the Savaneta Glauconitic Sandstone Member of the Springvale Formation. They are easily distinguished from each other, because *S. papulosus* has coarse ribs carrying heavy pustules, whereas *S. decussatus* has no pustules and finer sculpture. *S. papulosus* ranges from middle to late Miocene (Woodring, 1959, p. 161) and may be the forerunner of *S. decussatus* which ranges from late Miocene to Recent.

Occurrence.—Point Courbaril: K 8399, PJ 212, USGS 20431. Matura Bay: JS 67, USGS 18204, USGS 19860.

Genus PETALOCOCHUS Lea

Lea, H. C., 1843. Amer. Philas. Soc., Proc., vol. 3, p. 162

Type species (by monotypy), *Petalococonchus sculpturatus* Lea.

Petalococonchus sculpturatus alcimus Mansfield

Pl. 43, fig. 32

1867. *Petalococonchus sculpturatus* Lea, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3,

- p. 156 (part); reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 35.
1874. *Petalococonchus sculpturatus* Lea, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 438 (part).
1910. *Petalococonchus sculpturatus* Lea, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, pp. 5, 10 (part); reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 148, 153.
1925. *Petalococonchus sculpturatus* var. *domingensis* G. B. Sowerby I, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 226 (part), pl. 41, figs. 2, 4, 7.
1925. *Petalococonchus alcimus* Mansfield, U.S. Nat. Mus., Proc., vol. 66, art. 22, p. 51, pl. 9, figs. 2, 3, 4.
1934. *Vermetus (Petalococonchus) sculpturatus domingensis* (G. B. Sowerby I), Rutsch, Abh. Schweiz. Pal. Ges., vols. 54-55, p. 45, pl. I, figs. 11, 12, 13.
1938. *Petalococonchus alcimus* Mansfield, Vokes, Amer. Museum Novitates, No. 988, p. 4.
1942. *Vermetus (Petalococonchus) sculpturatus* (Lea), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 103.

Syntypes. — USNM 352674 (three specimens).

Type locality. — Springvale Quarry, Trinidad.

This form occurs at the base of the Melajo Clay only, where it is represented by eight specimens. The sculpture of the figured specimen is not prominent, because it is somewhat worn.

As pointed out by several authors the sculpture of *P. sculpturatus* is variable in strength and its growth habit not constant. As a result *P. domingensis* G. B. Sowerby I (1850, p. 51, pl. 10, fig. 9) from the middle Miocene of the Dominican Republic and *P. pulcher* (Böse) (1906, p. 32, pl. 3, figs. 22, 23) from the Miocene of Mexico are considered as synonyms. Pflug (1961), who figured the lectotype of *P. domingensis*, even included *P. alcimus* in the synonymy of *P. sculpturatus*.

Although the late Miocene *P. alcimus* has the same sculpture as *P. sculpturatus*, it may be considered as a subspecies on account of its larger size. In addition its growth habit is more regular. Loosely coiled tubes are not frequent among the Trinidad fossils as they are in material from the Gurabo Formation of the Dominican Republic, where *P. sculpturatus* is abundant.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad. Punta Gavilán Fm. (late Miocene), Falcón, Venezuela.

Petalocouchus cf. **floridanus** Olsson and Harbison

Pl. 43, fig. 33

A few small specimens from Matura are available. They are too fragmentary for a definite identification. Mostly they form an irregular short cylinder. The sculpture consists of longitudinal

ribs and concentrics of almost equal size giving a reticulate pattern. Later the concentrics are less prominent.

P. floridanus Olsson and Harbison (1953, p. 304, pl. 46, figs. 2, 2a) was described from the Pliocene and Recent faunas of Florida. It is assigned to the subgenus *Macrophragma* Carpenter by Keen (1961, p. 198). The Matura specimens are immature, and thus do not attain the size of Recent shells of *P. floridanus* at hand. The largest specimen from Matura, forming an irregular coil, is figured.

The form from the Gatun Formation of the Panama Canal Zone described by Woodring (1959, p. 161, pl. 29, fig. 9) as *P. aff. floridanus* is taken in the synonymy of *P. sculpturatus* by Olsson (1964, p. 195).

Occurrence. — JS 67, PJ 302, USGS 19860.

Family **POTAMIDIDAE**

Genus **BATILLARIA** Benson

Benson, 1842, Ann. Mag. Nat. Hist., vol. 9, p. 448.

Type species (by monotypy), *Cerithium zonale* Bruguière.

Batillaria species

Pl. 43, figs. 34, 35

Three specimens from the Melajo Clay are available. Two of them are well preserved but have lost their apices. The third one represents some of the early whorls but is corroded.

The genus *Batillaria* has been reviewed by Bequaert (1942). In the Western Atlantic he only recognized *B. minima* (Gmelin) (Systema Naturae, ed. 13, vol. 1, pt. 6, p. 3564, 1791) and two subspecies. According to Bequaert *B. minima* is found "in shallow brackish water where it lives in the mud of the intertidal zone." The two subspecies both have reduced sculpture, and are stout or slender respectively. *B. minima minima* itself is a strongly variable species as to general shape and strength of sculpture.

The apertural features of the Melajo fossils are the same as those of *B. minima* (see Bequaert, 1942, pl. 1, fig. 2). Their sculpture consists of several spirals, some of which are much stronger than the others, and conspicuous axials. The axials are not present on the lower half of the body whorl, where there are only about six primary spirals with two secondary spirals in their interspaces.

The Melajo fossils differ from the Recent *B. minima* by their stouter form and their heavier sculpture.

Occurrence.—K 9813.

Family **CERITHIIDAE**

Genus **CERITHIUM** Bruguière

Bruguière, 1789, *Encycl. Méth.*, *Histoire naturelle des vers*, vol. 1, p. xv.

Type species (by virtual tautonymy), *Cerithium adansonii* Bruguière (= *Cerithium erythraeonense* Lamarck).

Cerithium (subgenus ?) **harrisi** Maury

Pl. 45, figs. 14-16

1912. *Cerithium harrisi* Maury, *Acad. Nat. Sci. Philadelphia, Jour.*, ser. 2, vol. 15, p. 90, pl. 12, fig. 18.

1925. *Cerithium harrisi* Maury, *Maury, Bull. Amer. Paleont.*, vol. 10, No. 42, p. 212.

Shell of medium size, solid and stout. Protoconch with about two volutions. Sculptured whorls about five in number. Sculpture consists of three primary spirals which are more or less regularly noded. Their interspaces ornamented by two or three spiral threads. Suture indistinct. Aperture oval. Anterior canal short, bent backwards. Posterior channel conspicuous. Outer lip thickened, frilled within. There is a moderately pronounced varix opposite the outer lip.

Lectotype (herewith selected).—Cornell Univ., Paleont. Museum, Ithaca N.Y., unnumbered.

Dimensions of lectotype.—Height 15.2 mm, diameter 7.5 mm.

Type locality.—Along shore, 700 feet east of Brighton pier, near Pitch Lake, Trinidad.

C. harrisi is abundant in the Courbaril beds. Its sculpture usually is coarse and heavy, but specimens with finer sculpture occur as well. There are no varices on the spire whorls. The lectotype (which is refigured here) is not adult having only four sculptured whorls.

A few specimens from the Melajo Clay also represent this species. One of them is indistinguishable from Courbaril specimens; others have somewhat finer sculpture. A single worn and incomplete shell from Matura is identified as *C. cf. harrisi*.

Maury (1912, p. 91, pl. 12, fig. 19) described *C. isabellae* from the same locality as *C. harrisi*. They probably are the same. *C. tinkeri* Maury (1912, p. 92, pl. 12, fig. 17) has been described from a locality just south of the Pitch Lake, Trinidad, which is thought to be stratigraphically equivalent to the Courbaril beds. A natural

mould with the corresponding artificial cast from that locality, which are deposited at the Department of Geology of Cornell University, Ithaca, New York, seem to have been at least part of the type material. The preservation is so bad, that it seems best to consider *G. tinkeri* as a *nomen dubium*.

C. harrisi has the same type of sculpture as the Recent Caribbean *C. variabile* C. B. Adams (1845, p. 5) but is larger, much heavier, and has a larger apical angle. The lectotype of *C. variabile* has been figured by Clench and Turner (1950, pl. 37, fig. 2).

Occurrence. — Melajo River area: PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, K 8399, K 8400, K 12012, K 12013, K 12255, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 20433, USGS 20434, USGS 21778. Matura Bay: RR 230 (cf.).

Genus **BITTIUM** Leach

Leach, 1847, Ann. Mag. Nat. Hist., vol. 20, p. 270.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 154), *Murex reticulatus* Montagu.

Subgenus **BITTIOLUM** Cossmann

Cossmann, 1906, Essais de paléoconchologie comparée, pt. 7, p. 139.

Type species (by original designation), *Bittium podagrinum* Dall.

Bittium (Bittiolum) fretense, n. sp.

Pl. 45, figs. 12, 13

Shell small, stout. Protoconch consists of a little more than three rapidly enlarging, smooth volutions. Early sculpture consists of two spirals. Subsequently a third and fourth spirals as well as less prominent axials appear. On later whorls all the spirals and axials have the same strength forming a regular reticulate pattern with beads at the intersections. Body whorl with an inconspicuous varix after which the sculpture is reduced in strength and less regular. Whorl profile straight. Suture deeply incised. Base ornamented by about five spirals.

Holotype. — USNM 645372.

Dimensions of holotype. — Height 5.6 mm, diameter 2.0 mm.

Type locality. — Point Courbaril: USGS 10991.

This species is based on 11 specimens from the Courbaril beds. No outer lip is entirely preserved, but it seems to be thin. From the varix on the body whorl onward secondary spirals are usually intercalated.

B. fretense, n.sp. is related to the Recent Western Atlantic and Caribbean *B. varium* (Pfeiffer) (Arch. f. Naturg., vol. 6, p. 256, 1840). In *B. varium* the axials are more widely spaced and usually coarser than the spirals, and its whorls are more convex in later stages than in *B. fretense*. Both species have about five sculptured whorls, but they are somewhat higher in *B. fretense*.

B. galvestonense Harris (1895, p. 22, pl. 4, fig. 8) was described from a well near Galveston, Texas, from a depth of 2550 to 2871 feet, and its age indicated as upper Miocene. *B. galvestonense* has a regularly reticulate sculpture like *B. fretense* but is said to have varices on the spire whorls which are absent in *B. fretense*. *B. properatum* (Woodring) (1928, p. 338, pl. 25, fig. 12) from the Bowden Formation of Jamaica is more slender and the axial element of its sculpture more conspicuous than the spiral one.

Occurrence.—USGS 10991, USGS 20432.

Family CERITHIOPSIDAE

Genus CERITHIOPSIS Forbes and Hanley

Forbes and Hanley, 1853, History of British Mollusca, vol. 3, p. 364.

Type species (by monotypy), *Murex tubercularis* Montagu.

Subgenus CERITHIOPSIS s. str.

Cerithiopsis (Cerithiopsis) species

Pl. 45, fig. 11

1864. *Cerithiopsis* sp., Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35 (part); reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.

Shell small. Part of the protoconch preserved, consists of one smooth volution. Next whorl with a spiral on its lower half which is the lowest spiral on later whorls. This spiral is crossed by faint, opisthocyrt threads which soon become straight axials. A second spiral and later a third one appear above the primary spiral. They all are beaded at the intersections forming a regular pattern on late whorls. Suture furrowed. Base ornamented by one or two spirals. Anterior canal short. Inner lip with inconspicuous callus.

The lot of Guppy's *Cerithiopsis* sp. (USNM 115466) from Matura consists of two specimens. One represents the form described above, the other one is indeterminable but belongs to some other family.

It is not possible to name this Matura fossil which is represented only by a few shells, because the Recent species have not

been worked up yet. Numerous names have been used for Recent species. Bartsch (1911a) had started to work on *Cerithiopsis* from the West Coast of America and proposed several subgeneric names based on nuclear characters.

The Matura fossil superficially resembles the Recent Jamaican *C. flavum* (C. B. Adams), the lectotype of which has been figured by Clench and Turner (1950, pl. 37, fig. 11).

Occurrence. — PJ 302, USGS 18204, USGS 19860.

***Cerithiopsis* (subgenus ?) *emersoni* (C. B. Adams) Pl. 45, fig. 10**

- 1839. *Cerithium emersonii* C. B. Adams, Boston Soc. Nat. Hist., Jour., vol. 2, p. 284, pl. 4, fig. 10.
- 1864. *Cerithiopsis subulatum* Montagu, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.
- 1867. *Cerithiopsis punctatum* Linné, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 156; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 35.
- 1874. *Cerithiopsis punctatum* Linné, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 438.
- 1948. *Cerithiopsis (Laskeya) emersonii persubulata* Gardner, U.S. Geol. Sur., Prof. Paper 199-B, p. 204, pl. 27, fig. 4.
- 1950. *Cerithium emersonii* C. B. Adams, Clench and Turner, Occas. Papers on Mollusks, vol. 1, No. 15, p. 276, pl. 37, figs. 12-14.
- 1953. *Cerithiopsis (Laskeya) emersonii* (C. B. Adams), Olsson and Harbison, Acad. Nat. Sci. Philadelphia, Mon. 8, p. 301, pl. 48, fig. 1.

Lectotype. — Museum Comp. Zool., Cambridge, Mass., No. 156201.

Type locality. — Massachusetts.

This species occurs at Matura, but most of the specimens are somewhat worn. One immature shell shows part of the smooth protoconch and indications of the first sculpture which consists of axial riblets (see Olsson and Harbison, 1953, pl. 48, fig. 1).

The sculpture as a whole is somewhat variable in strength according to Recent specimens. The central spiral of Matura shells is weak compared with the other two spirals, because no adult whorls are represented where this spiral becomes stronger.

The specimen from the Pleistocene of South Carolina (USNM 325445), figured by Gardner, is indistinguishable from Matura shells. Weisbord (1962, p. 184, pl. 15, figs. 21, 22) questionably referred a small specimen from the Pliocene of Venezuela to *C. emersoni*.

As stated by Olsson and Harbison it is still uncertain which name should be used for this species. *C. emersoni* is usually assigned

to the subgenus *Laskeya* Iredale (Malac. Soc. London, Proc., vol. 13, p. 30, 1918), type species: *Turritella costulata* Möller 1842. According to the figure of *T. costulata* given by Jeffreys (British Conchology, vol. 5, pl. 81, fig. 5, 1869) that species has convex whorls, predominantly axial sculpture, and a different aperture, thus looking unlike *C. emersoni*.

Occurrence. — RR 230, PJ 302, USGS 19860.

Distribution. — Miocene to Recent (see Weisbord, 1962, p. 186).

Cerithiopsis (subgenus ?) species

A single specimen of $4\frac{1}{2}$ whorls from Matura is similar to *C. emersoni*. It has also three spirals, but the uppermost one is the weakest one, whereas in *C. emersoni* the central one is weaker than the others. Slightly prosocline axials form beads at the intersections. They are less prominent than the spirals.

Occurrence. — USGS 19860.

Genus **SEILA** A. Adams

Adams, A., 1861, Ann. Mag. Nat. Hist., ser. 3, vol. 7, p. 131.

Type species (by subsequent designation, Dall, 1889, Bull. Mus. Comp. Zool., vol. 18, p. 250), *Triphoris dextroversus* Adams and Reeve.

Seila cf. **adamsi** (H. C. Lea)

Pl. 45, fig. 9

The nomenclatorial history of *Seila adamsi* is summarized in the synonymy lists by Olsson and Harbison (1953, p. 302). Abbott (1958, p. 41), and Weisbord (1962, p. 192). The lectotype of *Cerithium terebrale* C. B. Adams has been figured by Clench and Turner (1950, p. 349, pl. 37, fig. 5).

A few incomplete specimens from Matura may represent the Recent *S. adamsi*. However, Recent specimens are somewhat stouter than the Matura fossils, an observation which has been made by Olsson and Harbison for Pliocene specimens from Florida. But the sculpture of Recent and fossil shells is identical.

From the Bowden Formation of Jamaica, Woodring (1928, p. 332) reported one specimen as *Seila* sp. This shell (USNM 369483) is stouter than the Matura specimens and in this respect closely resembles *S. adamsi*.

Occurrence. — K 10924, JS 67, PJ 302, USGS 19860.

Family **MODULIDAE**
Genus **MODULUS** Gray

Gray, 1942, Synopsis of the contents of the British Museum, ed. 44, p. 60.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 150), *Trochus modulus* Linné.

Modulus carchedonius (Lamarck)

1822. *Monodonta carchedonius* Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 7, p. 33.
1944. *Modulus carchedonius* Lamarck, Abbott, Johnsonia, vol. 1, No. 14, p. 5, pl. 2, figs. 5-7. For additional citations see this publication.
1953. *Modulus carchedonius* (Lamarck), Olsson and Harbison, Acad. Nat. Sci. Philadelphia, Mon. No. 8, p. 303, pl. 39, fig. 11.
1961. *Modulus carchedonius* Lamarck, Warmke and Abbott, Caribbean Sea-shells, p. 71, pl. 11 k.

A single incomplete specimen from Matura shows the body whorl and the base. The toothlike end of the inner lip is not preserved. The specimen probably is immature; it does not reach the size of Recent shells.

The Recent West Coast *M. catenulatus* Philippi (see Abbott, 1944, p. 6) is larger than *M. carchedonius*, has a smaller peripheral angle, and its umbilicus is less closed.

Occurrence. — K 10924.

Distribution. — Pliocene of southern Florida. Recent from the Greater Antilles to the northern coast of South America (see Warmke and Abbott, 1961, p. 327, map 17).

Family **ARCHITECTONICIDAE**
Genus **ARCHITECTONICA** Röding

Röding, 1798, in Museum Boltenianum, pt. 2, p. 78.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 151), *Trochus perspectivus* Linné.

Subgenus **ARCHITECTONICA** s. str.

Architectonica (Architectonica) nobilis nobilis Röding Pl. 45, figs. 7, 8

1798. *Architectonica nobilis* Röding, in Museum Boltenianum, pt. 2, p. 78.
1959. *Architectonica (Architectonica) nobilis nobilis* Röding, Woodring, U.S. Geol. Sur., Prof. Paper 306-B, p. 165, pl. 29, figs. 1-6, 10-12, 14-16. For further citations see this publication.
1965. *Architectonica (Architectonica) nobilis nobilis* Röding, Jung, Bull. Amer. Paleont., vol. 49, No. 223, p. 486, pl. 64, figs. 1-7.

This species is rare at Matura. A single specimen is known from the base of the Melajo Clay.

Occurrence. — Melajo River area: USGS 18634. Matura Bay: RR 230, PJ 302, USGS 18204.

Distribution. — Widespread from lower Miocene to Recent (see Woodring, 1959, p. 167).

Subgenus **PSEUDOTORINIA** Sacco

Sacco, 1892, I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 12, p. 66.

Type species (by original designation), *Solarium obtusum* Bronn.

Architectonica (Pseudotorinia) melajoensis, n.sp. Pl. 46, figs. 1-3

Small, spire but little elevated. The anastrophic protoconch shows $1\frac{1}{2}$ volutions on the dorsal surface. Postnuclear whorls three. First sculpture with two beaded spirals close to the lower and upper sutures respectively. Their beads are connected by prosocline axial threads. Between these two spirals three minor ones are intercalated, the uppermost one appearing first. All of them are crossed by axials. On the body whorl the spiral next to the suture is the most prominent one. Periphery rounded. Umbilicus wide, bordered by a broad spiral carrying radially elongated nodes. Surface between this spiral and periphery sculptured by beaded spirals; one of them is more prominent than the others. Basal spirals crossed by radial threads.

Holotype. — Natural History Museum Basel, No. H 14640.

Dimensions of holotype. — Height 2.0 mm, diameter 4.8 mm.

Type locality. — Melajo River area: PJ 285.

This species is represented by the holotype only. Its periphery is formed by two subequal, noded spirals which, however, do not produce an angulation.

A. eurybis Olsson (1964, p. 185, pl. 33, figs. 6-6b), from the middle Miocene Angostura Formation of northwestern Ecuador, is a larger species with a somewhat higher spire. Its periphery is more rounded, and its umbilicus is bordered by two broad, noded spirals with a narrow interspace, whereas *A. melajoensis* has only one. *A. eurybis* is more closely related to *A. nupera* (Conrad) (1831, p. 141) from the Miocene Yorktown Formation of Virginia than is *A. melajoensis*. According to Gardner's figures [1913-1918 (1918), pl. 24, figs. 8, 11, 15] *A. nupera* has two broad, noded spirals bor-

dering the umbilicus like *A. eurybis*. Like in *A. melajoensis* the uppermost spiral on the dorsal surface is more prominent than the others which is not the case in *A. eurybis*. The Recent *Heliacus mazatlanicus* Pilsbry and Lowe (1932, p. 83, pl. 8, figs. 6, 7, 8) from Mazatlan, Mexico, is similar to *A. eurybis*.

A. euprepes Woodring (1928, p. 357, pl. 27, figs. 15-17) from the Bowden Fm. of Jamaica is easily distinguishable from *A. melajoensis* by its sharp peripheral angulation. Its spirals are usually broader and more coarsely beaded leaving narrower interspaces. *A. watsonensis* Mansfield (1930, p. 111, pl. 16, figs. 5, 6) from the *Ecphora*-zone of Florida has been described originally as a subspecies of *A. nupera*. It is almost twice as large as *A. melajoensis* and is more coarsely sculptured.

Occurrence. — PJ 285.

Architectonica (Pseudotorinia) guppyi, n.sp.

Pl. 46, figs. 4-6

Small, spire low. Visible part of anastrophic protoconch consists of one volution. At three-quarters of this volution the protoconch is broad and inflated. Postnuclear whorls $2\frac{1}{2}$. Sculpture starting abruptly, consists of five spirals which are crossed by prosocline axials. With increasing age beads are formed at the intersections. On the penultimate and the body whorl a more prominent, noded spiral appears forming the upper and more conspicuous of the two peripheral spirals. Periphery slightly angulated. Umbilicus wide, bordered by two broad, subequal spirals carrying radially elongated nodes. Their interspace narrow. Toward the periphery follow four spirals of gradually decreasing width. They are crossed by many radial threads converging toward the nodes of the two innermost spirals.

Holotype. — Natural History Museum Basel, No. H 14641.

Dimensions of holotype. — Height 2.0 mm, diameter 4.2 mm.

Type locality. — Matura Bay: JS 67.

This species is represented by several, partly well-preserved specimens from Matura. It has some resemblance with the Recent Caribbean *A. bisulcata* (d'Orbigny) (1842, pl. 19, figs. 17-20; 1845, p. 188). *A. bisulcata*, however, has a more pronounced peripheral angulation, and the visible part of its protoconch is smaller and less inflated. Gardner [1926-1950 (1947), p. 590] included what she thought to be *A. semidecussata* in the synonymy of *A. bisulcata*.

Woodring (1959, p. 168) proposed *Astronacus* as a subgenus of *Heliacus* with *Heliacus planispira* Pilsbry and Lowe (1932, p. 83, pl. 8, figs. 9, 10, 11), from the Recent fauna of Mazatlan, Mexico, as its type species. *Astronacus* includes low-spired, bicarinate species with strong dorsal axial sculpture. A feature of eventual taxonomic importance is mentioned, namely the greater inflation and cruder sculpture on the first one-fourth of the first sculptured whorl. A similar inflation, but situated on the last part of the protoconch already, is observed in *A. guppyi*. Thus *A. guppyi* has several affinities with *Astronacus* except that its periphery is less angulated, and its axial sculpture not predominant.

A. guppyi is also similar to *A. melajoensis*, n. sp., but at once distinguishable by its wider protoconch, more angulated periphery, and the sculpture on the base. Despite of their differences, it would seem artificial to place them in different subgenera.

Occurrence. — JS 67, PJ 302, USGS 19860.

Architectonica (Pseudotorinia) semidecussata (Guppy) Pl. 46, figs. 10, 11

1867. *Solarium semidecussatum* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 170; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 35, 49.
 1874. *Solarium semidecussatum* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 408, pl. 18, fig. 14.
 1925. *Solariella* (?) *semidecussata* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 248.

Small, spire relatively high. Visible part of anastrophic protoconch consists of one volution. Postnuclear whorls 2 $\frac{3}{4}$. Sculpture consists of prosocline axials which are crossed by five spirals, the uppermost spiral being the broadest one. Periphery almost rounded. Umbilicus wide, bordered by one broad spiral carrying radially elongated nodes.

Holotype. — USNM 115468.

Dimensions of holotype. — Height 2.1 mm, diameter 4.0 mm.

Type locality. — Matura, Trinidad.

The holotype is the only specimen known. It is strongly rolled leaving sculptural details obscure. Guppy's original description is misleading as the type lot originally included two specimens belonging to different genera (see under *Microgaza oblita*, n. sp.).

A. semidecussata is at once distinguishable from *A. guppyi*, n. sp., with which it occurs, by its higher spire. Some specimens of

A. guppyi have an almost flat dorsal surface. In addition *A. semidecussata* has only one spiral band bordering the umbilicus, whereas *A. guppyi* has two of them.

The sculpture of the base is more like that of *A. melajoensis*, but that species has also a lower spire and a much smaller protoconch.

Occurrence. — Matura Bay. Guppy coll.

Distribution. — Known from type locality only.

Architectonica (Pseudotorinia) cf. semidecussata (Guppy) Pl. 46, figs. 7-9

There is a single specimen from the Courbaril beds. It is much larger than the type of *A. semidecussata* measuring 3.8 mm in height and 7.2 mm in diameter. It has a large protoconch, the same type of sculpture, and about the same apical angle as *A. semidecussata*. The umbilicus is also bordered by a single, broad, spiral band carrying radially elongated nodes. The periphery is but slightly angulated.

The Courbaril specimen is also similar to *A. eurybis* Olsson referred to under *A. melajoensis* but differs from that species by its basal sculpture.

Occurrence. — USGS 10991.

Family **MATHILDIDAE**

Genus **MATHILDA** Semper

Semper, 1865, Jour. de Conchyliologie, vol. 13, p. 330.

Type species (by subsequent designation, Cossmann, 1888, Catalogue illustré des coquilles fossiles de l'éocène des environs de Paris, fasc. 3, p. 309), *Turbo quadricarinatus* Brocchi.

Mathilda species A

Pl. 46, figs. 12, 13

Shell of small to medium size, with about 10 moderately convex whorls. First sculpture consists of a medial spiral and faint axial threads. A second spiral is introduced below the primary one. After a few whorls a third spiral appears above the primary one and reaches almost the strength of the other spirals on late whorls. A fourth, but faint spiral below the upper suture, is present on late whorls. The axial threads are regularly spaced except on the body whorl, where they are crowded. They do not cross the spirals, thus producing no beads at the intersections. Interspaces of spirals

sculptured by minute spiral striae. Suture prominent. Aperture almost circular. Basal lip slightly everted.

The above description is based on a single somewhat worn specimen from the base of the Melajo Clay (height 10.0 mm, diameter 3.6 mm). Its protoconch is missing. Two fragments and a worn specimen of seven whorls from the Matura shell bed are identified provisionally as *Mathilda* species A ?. Their state of preservation leaves some doubt as to this determination.

The Melajo specimen is easily distinguished from *M. plexita* Dall (*in* Guppy and Dall, 1896, p. 320, pl. 29, fig. 5; Woodring, 1928, p. 406, pl. 32, figs. 7, 8) from the Bowden Formation of Jamaica, by its less convex whorls and the less incised suture. *M. plexita* has four spirals of almost equal size which are beaded at the intersections with the axials and differs in other details of the sculpture. The Melajo specimen has a larger apical angle than *M. plexita*. As pointed out by Woodring (1928, p. 406) the specimen (USNM 107120) from the "*Ditrupa*" bed near Pointe-à-Pierre, Trinidad (Upper Concord Marl Member of Tamana Formation: middle Miocene), is a small fragment slightly differing from topotypes of *M. plexita*.

The form from the Bowden Formation of Jamaica, recorded by Woodring (1928, p. 406) as *Mathilda* species, is also more slender than the Melajo specimen, and it has stronger axial sculpture.

Occurrence.—Melajo River area: USGS 18411. Matura Bay: PJ 302 (?).

Mathilda species B

A small fragment of four whorls from the Courbaril beds is similar to *Mathilda* species A. It differs from it by its more regularly convex whorls, *i.e.* by a less prominent primary spiral, and by its stronger axial sculpture. The apical angle is about the same in both forms.

Occurrence.—USGS 10991.

Family **TRIPHORIDAE**

Genus **TRIPHORA** Blainville

Blainville, 1828, Dictionnaire des sciences naturelles, vol. 55, p. 344.

Type species (by monotypy), *Triphora gemmatum* Blainville (= *Cerithium tristoma* Blainville).

Triphora guttata (Guppy)

Pl. 46, figs. 14-16

1864. *Triforis ventricosus* Gmelin, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.
1867. *Triforis guttata* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 170; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 35, 49.
1874. *Triforis guttata* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 408, 438, pl. 18, fig. 27.

Shell small, stout. Protoconch consists of five whorls. First volution smooth. Subsequent nuclear whorls with fine axials and at first one, later two spirals. On the last nuclear whorl one spiral disappears, the other one becomes stronger, and forms the lower of the two beaded spirals on the first postnuclear whorl. Postnuclear whorls about seven in number, the first ones with two beaded spirals and axials. Later a weak third spiral appears centrally which is also beaded, where it crosses the axials. On the body whorl it has about the same strength as the other spirals. Base sculptured by three spirals. Anterior canal short, bent backwards. Posterior canal not recognizable. Inner lip with a well-defined callus. Outer and basal lips not preserved.

Holotype. — USNM 115458.

Dimensions of holotype. — Height 3.1 mm, diameter 1.3 mm.

Type locality. — Matura, Trinidad.

The holotype is the only specimen in Guppy's collection. It is incomplete, somewhat worn, and has been glued to a card. *T. guttata* occurs at Matura and in the Courbaril beds. A protoconch of an unidentified *Triphora* has been found in the Melajo Clay (USGS 18399).

The Recent West Indian *T. melanura* (C. B. Adams) (see Clench and Turner, 1950, p. 307, pl. 38, fig. 10) has the same type of protoconch as *T. guttata*. All its whorls have the same apical angle, whereas in *T. guttata* the apical angle of later whorls becomes smaller. In general outline *T. guttata* looks more like the Recent *T. modesta* (C. B. Adams) (see Clench and Turner, 1950, p. 310, pl. 39, fig. 8).

Olsson and Harbison (1953, pp. 295, 296) proposed *Cosmotriphora* and *Cinctrifora* as subgenera of *Triphora* mainly on the basis of nuclear characters. Kosuge (1966, pp. 309-310) distinguished three types of protoconchs in the Triphoridae which are only of secondary taxonomic importance. Kosuge defined triphorid

genera mainly by apertural features, sculpture, radula, and operculum. *T. guttata* would have to be assigned to *Cosmotriphora*.

Occurrence.—Point Courbaril: PJ 212, USGS 10991, USGS 20434. Matura Bay: K 10924, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution.—Courbaril beds of Upper Morne l'Enfer Fm. Matura shell bed.

Family EPITONIIDAE

Genus EPITONIUM Röding

Röding, 1798, in *Museum Boltinianum*, pt. 2, p. 91.

Type species (by subsequent designation, Suter, 1913, *Manual of New Zealand Mollusca*, p. 319), *Epitonium scalare* Röding (= *Turbo scalaris* Linné).

Subgenus EPITONIUM s.str.

Epitonium (Epitonium) albidum (d'Orbigny)

Pl. 46, fig. 17

1845. *Scalaria albida* d'Orbigny, in *La Sagra, Historia fisica, política y natural de la Isla de Cuba. Segunda parte. Historia Natural. Tomo 5, Moluscos*, p. 157. Atlas, pl. 10, figs. 24, 25, 1842.

1853. *Scalaria albida* d'Orbigny, in *La Sagra, Histoire physique, politique et naturelle de l'Ile de Cuba. Mollusques, vol. 2*, p. 17.

1951. *Epitonium (Epitonium) albidum* d'Orbigny, Clench and Turner, *Johnsonia*, vol. 2, No. 30, p. 260, pls. 113, 114. For further citations see this publication.

1952. *Epitonium (Epitonium) albidum* d'Orbigny, Clench and Turner, *Johnsonia*, vol. 2, No. 31, p. 351, pl. 174.

This species is fairly common at Matura. According to the Recent material of *E. albidum* at hand the apical angle is somewhat variable. The figured Matura specimen is more slender than the others and its axial lamellae slightly more oblique. Some tips assumed to belong to this species have a protoconch with three whorls.

Occurrence.—JS 67, RR 230, PJ 302, USGS 19860.

Distribution.—Recent from Florida through the West Indies to northern Argentina. *E. albidum* is also recorded from a few localities on the West African coast (see Clench and Turner, 1951, p. 262).

Epitonium (Epitonium) aff. foliaceicostum (d'Orbigny)

A number of small fragments and tips from the Courbaril beds

and the Melajo Clay are identified as *E. aff. foliaceicostum*. The tips show protoconchs with three whorls, whereas the Recent *E. foliaceicostum* (see Clench and Turner, 1951, p. 273, pl. 123, figs. 1-3, pl. 124, figs. 1, 2) has only $1\frac{1}{2}$ volutions. The early sculptured whorls cannot be separated from corresponding whorls of Recent specimens. There are about 10 axial lamellae at that growth stage which carry hooklike prolongations at the shoulder of the whorls.

Olsson and Harbison (1953, p. 336, pl. 58, fig. 2) reported *E. cf. foliaceicostum* from the Pliocene of Florida. The specimens from the middle Gatun Formation of the Panama Canal Zone identified as *E. cf. foliaceicostum* by Woodring (1959, p. 182, pl. 38, figs. 13, 16) have four nuclear whorls and are more slender than those from the Courbaril beds and the Melajo Clay.

Occurrence.—Melajo River area: KR 11862, PJ 285, USGS 18399. Point Courbaril: K 1429, USGS 10991, USGS 20433, USGS 20434.

Epitonium (Epitonium) humphreysi (Kiener) ?

Pl. 46, fig. 18

1838. *Scalaria humphreysi* Kiener, Iconographie des coquilles vivantes, vol. 10, p. 15, pl. 5, fig. 16.

1951. *Epitonium (Epitonium) humphreysi* Kiener, Clench and Turner, Johnsonia, vol. 2, No. 30, p. 268, pl. 117, fig. 2, pls. 119, 120. For further citations see this publication.

Two incomplete specimens from the Courbaril beds seem to represent this species. The axial costae are fused at the margin of the inner lip, a feature which is observable on Recent specimens of *E. humphreysi*.

The larger and figured specimen has a little more than two whorls. The smaller specimen has four whorls and nine thickened lamellae on its last whorl. The axials are somewhat angulated on the shoulders which is typical for the early stages of *E. humphreysi* according to Clench and Turner.

Occurrence.—K 1429, USGS 10991.

Epitonium (Epitonium) maturense, n. sp.

Pl. 46, figs. 20, 21

Of medium size, stout. Whorls loosely coiled; sutures open; the whorls connected by the axial lamellae. There are six axial lamellae per whorl. They are thin, curved backwards, and angulated on the shoulders. They are continuous from whorl to whorl, and form a spiral completing one turn within six whorls. Surface between varices smooth. Aperture circular. No basal disk.

Holotype. — Natural History Museum Basel, No. H 15040.

Dimensions of holotype. — Height 18.9 mm, diameter 8.1 mm.

Type locality. — Matura Bay: RR 230.

This species is based on three specimens from Matura. The holotype has seven whorls, but the apex is lost. One of the paratypes is immature (four whorls). The other paratype consists of a little more than four later whorls, and its axial lamellae are even larger than those of the holotype.

E. helikum Olsson and Harbison (1953, p. 335, pl. 58, figs. 1, 1a) was described from the Pliocene of St. Petersburg, Florida. It is much larger than *E. maturense*, its holotype (three whorls) is 23.7 mm high and has only four or five varices.

The Recent *E. strongi* Lowe (1932, p. 115, pl. 9, fig. 5) from the West Coast of Central America has about the same dimensions as *E. maturense*. It has only five varices per whorl, its whorls are compactly united and not loosely coiled. It is said to have faint spiral sculpture between the varices and a weak thread defining the base. Lowe (*Nautilus*, vol. 46, p. 36) renamed his species *strongianum* as it was preoccupied by *E. strongi* Bartsch (Wash. Acad. Sci., Jour., vol. 18, No. 3, p. 71, fig. 2, 1928). But *E. strongianum* is considered a synonym of *E. statuminatum* (G. B. Sowerby II) (*Zool. Soc. London, Proc.*, pt. 12, p. 30, 1844; *Thes. Conch., Scularia*, pl. 35, fig. 127) by Keen (1958, p. 274).

Occurrence. — RR 230.

Subgenus **ASPERISCALA** de Boury

De Boury, 1909, *Jour. de Conchyliologie*, vol. 57, p. 257.

Type species (by original designation), *Scularia bellastriata* Carpenter.

Epitonum (Asperiscala) cf. multistriatum (Say) Pl. 46, fig. 19

One incomplete, somewhat worn specimen (height 5.9 mm, diameter 3.0 mm) from Matura shows part of its protoconch and four sculptured whorls. The last whorl has 26 axial costae which are not continuous from whorl to whorl. Their interspaces are crossed by numerous, faint spirals.

The Recent *E. multistriatum* (Say) (see Clench and Turner, 1952, p. 292, pls. 133, 134) has 16 to 19 costae on the body whorl

but many more on earlier whorls. The Matura fossil has the same inflation of the whorls as the Recent species.

Occurrence. — RR 230.

Epitonium (Asperiscala) cf. candeanum (d'Orbigny) Pl. 46, fig. 22

Small, slender. Whorls strongly convex, especially in later stages. Sutures deep. Axial lamellae low, numbering about 13 on last preserved whorls. Interspaces of costae sculptured by numerous, faint spiral threads.

A few fragmentary shells from Matura may represent the Recent *E. candeanum* (d'Orbigny) (see Clench and Turner, 1952, p. 301, pls. 140, 141) which ranges from Florida through the Bahamas and the Lesser Antilles to Barbados. The number of axials seems to be variable in this species. According to Clench and Turner there are 18 to 25 costae on the body whorl. But Recent specimens of the size of the Matura shells have also about 13 costae.

Occurrence. — PJ 302, USGS 19860.

Epitonium (Asperiscala) rohri, n. sp.

Pl. 46, figs. 23-25

Small, slender. Protoconch of four little convex, smooth volutions. Postnuclear whorls a little more than five in number, tightly coiled, strongly but not uniformly convex, somewhat angled just above the middle of the whorls. Axial sculpture consists of fairly uniform, low, oblique lamellae numbering 16 to 18 per whorl. They are continuous from whorl to whorl. Interspaces between lamellae sculptured by spirals which, however, are reduced or absent on the upper half of the whorl. Suture moderately deep. Aperture sub-circular.

Holotype. — Natural History Museum Basel, No. H 15042.

Dimensions of holotype. — Height 4.8 mm, diameter 1.6 mm.

Type locality. — Melajo River area: PJ 285.

This species is represented from the Melajo Clay by about 50 specimens. According to this material its characters are constant. Two fragments from the Courbaril beds are also assigned to this species.

E. rohri, n. sp. is most closely related to the Recent *E. sericifilum* (Dall) (1889a, p. 313). Its holotype (USNM 61190) has been figured by Clench and Turner (1952, p. 317, pl. 152). It has been collected on the coast of Honduras and is the only specimen

known. *E. sericifilum* has four nuclear whorls (not $2\frac{1}{2}$ as stated by Clench and Turner) like *E. rohri*, and about the same apical angle but differs in having 25 axials per whorl. In addition the spiral sculpture of *E. sericifilum* is much finer, and not restricted to the lower part of the whorl.

The Recent western American *E. durhamianum* Hertlein and Strong [1940-1951 (1951), p. 89, pl. 3, fig. 9] from Nicaragua has about the same number of axial lamellae per whorl, but they are not angulated as in *E. rohri*. *E. durhamianum* lacks any spiral sculpture.

Occurrence.—Melajo River area: EL 1810, KR 11862, PJ 285, USGS 18399. Point Courbaril: USGS 20434.

Distribution.—Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm..

Epitonium (Asperiscala) aff. sericifilum (Dall)

A single, incomplete specimen (height 3.5 mm) from Matura has about the same number of axial lamellae as *E. sericifilum* referred to under *E. rohri*, n. sp. However, its whorls are less angulated, and its apical angle is clearly larger.

The Matura specimen shows part of its protoconch and four postnuclear whorls. Its spiral sculpture between the axials is as fine as in *E. sericifilum* and also not restricted to the lower part of the whorl as in *E. rohri*.

Occurrence.—PJ 302.

Family **ACLIDIDAE**

Aclis helecteroides Guppy

1867. *Aclis helecteroides* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 169; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 48.
1874. *Aclis helecteroides* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 407, 437, pl. 18, fig. 11.

Guppy described this species from Matura. It should be considered as a *nomen dubium*, because the type or any other specimens labelled by Guppy are missing. No additional shells have since been collected at Matura.

Family **EULIMIDAE**

Genus **EULIMA** Risso

- Risso, 1826, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 123.

Type species (by subsequent designation, Herrmannsen, 1846, *Indicis generum malacozoorum primordia*, vol. 1, p. 431), *Turbo subulatus* Donovan (= *Strombiformis glaber* da Costa).

***Eulima clavata* (Guppy)**

Pl. 46, fig. 26

1867. *Leiostraca clavata* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 169; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 48.

1874. *Leiostraca clavata* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 408, 437, pl. 18, fig. 16.

Small, slender. Whorls smooth, flat, about 10 in number. Apical angle of first four whorls small, slightly enlarging afterwards. Suture feebly incised. Aperture pointed above, rounded below. Outer lip thin, inner lip with a small, but well-defined callus. This callus slightly thickened on columella.

Lectotype (herewith selected). — USNM 115443.

Dimensions of lectotype. — Height 6.7 mm, diameter 1.7 mm.

Type locality. — Matura, Trinidad.

Guppy's original lot consisted of 11 specimens. The lectotype is the only complete shell. *E. clavata* is fairly common at Matura being represented by about 50 specimens in later collections. Comparisons are omitted, because the Recent Caribbean Eulimidae are not worked up yet.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

***Eulima* species A**

Pl. 46, fig. 27

1942. *Strombiformis* sp. ind. aff. *dalli* Gardner and Aldrich, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 135, pl. 4, fig. 6.

Shell slender. Protoconch consists of almost four glassy whorls. Postnuclear whorls nine, smooth, flat. Suture indistinct. Aperture pointed above, rounded below. Inner lip with a weak, but well defined callus.

This form is represented from the Melajo Clay by a few shells. It also occurs in the Savaneta Glauconitic Sandstone Member of the Springvale Formation. Two incomplete specimens from the Courbaril beds are doubtfully referred to it.

Comparison with the type specimen of *E. dalli* (Gardner and Aldrich) (1919, p. 39, pl. 2, fig. 5), from the Caloosahatchee Formation of Florida, shows that *E. dalli* is even more slender than the Melajo form, and that its protoconch has only about two whorls.

E. nobilis Guppy (in Guppy and Dall, 1896, p. 315, pl. 30, fig. 9) from the Bowden Formation of Jamaica is smaller. None of the four syntypes has the protoconch preserved.

Occurrence. — Melajo River area: PJ 285, USGS 21178. Point Courbaril: K 8399 (?), PJ 212 (?).

Genus **BALCIS** Leach

Leach, 1847, in Gray, Ann. Mag. Nat. Hist., vol. 20, p. 271.

Type species (by monotypy), *Balcis montagui* Leach (= *Strombiformis albus* da Costa).

Balcis egregia (Guppy)

Pl. 47, figs. 1, 2

1896. *Eulima egregia* Guppy, in Guppy and Dall, Proc. U. S. Nat. Mus., vol. 19, p. 314, pl. 28, fig. 11.

1910. *Eulima egregia* Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, pp. 5, 8; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 148, 150.

1925. *Melanella (Eulima) egregia* Guppy, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 215, pl. 35, fig. 3.

1938. *Eulima egregia* Guppy, Vokes, Amer. Museum Novitates, No. 988, p. 5.

1942. *Melanella (Eulima) egregia* (Guppy), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 134.

Large, solid, stout. Whorls smooth, flat, numbering up to 17. Suture sharply incised. Body whorl evenly rounded. Aperture angulated above, rounded below. Outer lip thin, arched forward on lower part when viewed from side. Inner lip with a callus reaching down to the basal lip.

Holotype. — USNM 107082.

Type locality. — "Montserrat", Trinidad (Guppy).

The type locality of this species as indicated by Guppy cannot be reconstructed precisely. The holotype, an incomplete specimen of 11 whorls, was probably collected from the Savaneta Glauconitic Sandstone Member of the Springvale Formation at a spur of the Montserrat range. Guppy later listed *B. egregia* from Springvale Quarry, where it is fairly common.

In the material under consideration *B. egregia* is represented by a few specimens from the base of the Melajo Clay. At irregular intervals there are accentuated growth lines making an interruption in growth. *B. egregia* is unique in its large size. The figured specimen from the Melajo Clay is the largest one so far known (height 19.5 mm, diameter 14.3 mm). It has 17 whorls (apex broken).

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Balcis species A

Small, stout, with about 10 flat whorls. Suture indistinct. Aperture oval, pointed above, rounded below. Inner lip with a weak callus. Outer lip somewhat arched when viewed from side.

A few incomplete, worn specimens from Matura are at hand. They resemble in general aspect the Recent *B. intermedia* Cantraine as figured by Warmke and Abbott (1961, pl. 26 h, text fig. 13 c). A specimen with five late whorls is 7 mm high.

Occurrence. — RR 230, PJ 302, USGS 18204, USGS 19860.

Genus NISO Risso

Risso, 1826, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 218.

Type species (by monotypy), *Niso eburnea* Risso.

Niso grandis Gabb ?

Pl. 47, figs. 3, 4

1873. *Niso grandis* Gabb, Amer. Philos. Soc., Trans., new ser., vol. 15, p. 227.

1917. *Niso grandis* Gabb, Maury, Bull. Amer. Paleont., vol. 5, No. 29, p. 143, pl. 24, fig. 8.

1922. *Niso grandis* Gabb, Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., vol. 73, p. 394, pl. 34, fig. 17.

Of medium to large size. Whorls smooth, flat to slightly convex. At irregular intervals there are conspicuous growth lines in addition to a minute axial striation. Whorls usually with an angulated periphery but less so in adult stages.

Type. — Acad. Nat. Sci. Philadelphia, No. 3018.

Type locality. — Dominican Republic (Cercado Fm.: middle Miocene).

This species occurs in the Melajo Clay. Most of the specimens are immature, and their whorls have an angulated periphery. But late whorls may be entirely rounded at the periphery. However, there is some variability as to the peripheral angulation as there are immature specimens showing no angulation on the spire whorls.

The Melajo specimens tend to have flatter whorls than those from the Cercado Formation of the Dominican Republic. The largest Dominican shells at hand have up to 18 whorls reaching a height of 23.3 mm. They show a similar variability of the peripheral angulation of the whorls as the Melajo specimens. The same is true for material from the Bowden Formation of Jamaica.

However, the Bowden specimens have a somewhat larger apical angle, their whorls are lower on an average, and their umbilicus is slightly wider.

According to a topotype of *N. striatula* Böse (in Böse and Toula, 1910, p. 227, pl. 12, fig. 7), i.e. from late Miocene beds at kilometer 70 of the Tehuantepec Railroad, Mexico, that species has a larger apical angle, and lower and more convex whorls. The same applies to specimens from the Gatun Formation of the Panama Canal Zone.

Rutsch (1942, p. 136, pl. 4, figs. 7a, 7b) recorded a single large, but incomplete specimen from the Springvale Formation as *Niso* sp. ind. aff. *grandis*. This specimen seems to be closer to *N. striatula*. Additional specimens from Springvale are somewhat more slender, and have flat whorls. Their umbilicus is wider than in *N. grandis*, and the umbilical margin is more sharply angulated. These specimens then are difficult to distinguish from *N. willcoxiana gunteri* Mansfield (1930, p. 91, pl. 12, fig. 9) from the upper Miocene of Florida.

Occurrence. — EL 1810, K 9797, PJ 285, USGS 18399, USGS 21178.

Niso species

A small species of *Niso* occurs at Matura but is represented only by a few mostly immature specimens. The whorls are slightly convex and smooth, the suture not deep, the body whorl not sharply angulated at the periphery, and the umbilicus small. A specimen with 10 whorls including the protoconch measures 4.9 mm in height.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Family **FOSSARIDAE**

Genus **FOSSARUS** Philippi

Philippi, 1841, Archiv für Naturgeschichte, year 7, vol. 1, pp. 42, 47.

Type species (by monotypy), *Fossarus adansonii* Philippi (= *Turbo ambiguus* Linné).

Subgenus **ISELICA** Dall

Dall, 1918, Biol. Soc. Washington, Proc., vol. 31, p. 137 (new name for *Isapis* H. and A. Adams, The Genera of Recent Mollusca, vol. 1, p. 320, 1854).

Type species (by monotypy), *Narica* (?) *anomala* C. B. Adams.

Fossarus (Iselica) anomalus (C. B. Adams) ?

Pl. 47, fig. 5

1850. *Narica* (?) *anomala* C. B. Adams, Contributions to Conchology, No. 7, p. 109.
 1890. *Isapis caloosaensis* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., vol. 3, pt. 1, p. 187, pl. 9, fig. 10.
 1892. *Fossarus (Isapis) anomala* C. B. Adams, Dall, *ibidem*, vol. 3, pt. 2, p. 322.
 1950. *Narica* (?) *anomala* C. B. Adams, Clench and Turner, Occas. Papers on Mollusks, vol. 1, No. 15, p. 256, pl. 39, fig. 14.
 1961. *Iselica anomala* C. B. Adams, Warmke and Abbott, Caribbean Seashells, p. 85, pl. 15 c.

Shell small, solid. Protoconch immersed at the tip, smooth, consists of a little less than one volution. Early sculpture of three strong spirals which appear almost simultaneously. Between the spirals there are numerous fine, slightly prosocline axials. Uppermost one of the three primary spirals forming a prominent shoulder. Between shoulder and upper suture a fourth, but weaker, spiral appears which is strongly noded by the axials. Last whorl with eight spirals which are slightly beaded by the axials. Umbilicus wide. Aperture oval. Outer lip denticulated by spirals. Inner lip with callus which is heavier on lower part. Columella with a small, transverse plait opposite the umbilicus.

Lectotype.—Museum of Comparative Zoology, Cambridge, Mass., No. 186034.

Type locality.—Jamaica.

This form is represented by 20 specimens from Matura. All of them are immature as they do not have more than $2\frac{1}{2}$ sculptured whorls. No Recent specimens are at hand, but they are said to reach a height of 5 mm.

The type specimen of *F. anomala floridana* Mansfield (1930, p. 112, pl. 15, fig. 6) from the Miocene *Cancellaria* Zone of Florida is immature. Its spirals are less prominent, and its axial sculpture consists of more numerous and more closely set, but weaker threads.

F. floriis Gardner [1926-1950 (1947), p. 571, pl. 57, fig. 30], from the Shoal River Formation of Florida, is related to *F. anomala floridana* and may be its forerunner. It differs mainly from it by its much less inflated protoconch. *F. floriis* has a larger aperture than the Matura specimens. They both have the same number of spirals on the whorls, but in *F. floriis* the shoulder is formed by the upper-

most spiral, whereas the Matura fossils still have a spiral between shoulder and upper suture.

Occurrence. — JS 67, PJ 302.

Distribution. — Pliocene, Florida. Recent, West Indies.

Family **HIPPONICIDAE**

Genus **HIPPONIX** Defrance

Defrance, 1819, Journal de physique, de chimie, d'histoire naturelle et des arts, vol. 88, p. 217.

Type species (by subsequent designation, Gray, 1817, Zool. Soc. London, Proc., pt. 15, p. 157), *Patella cornucopia* Lamarck.

Hipponix cf. **antiquatus** (Linné)

Pl. 47, figs. 6, 7

A single specimen (height 9 mm, greatest diameter 14.1 mm) from Matura is available. The apex is closer to the margin than to the center of the shell. The sculpture consists of coarse, concentric lamellae. The specimen is so worn that no radial sculpture is preserved. The shell wall is thick and solid and the horseshoe-shaped muscle scar well recognizable.

H. antiquatus (Linné) (Systema Naturae, ed. 12, p. 1259, 1767) has been recorded from the Pleistocene of Cuba and Barbados. In Recent seas it ranges from southeastern Florida through the West Indies to Brasil (see also Weisbord, 1962, p. 204).

Occurrence. — RR 230.

Family **CALYPTRAEIDAE**

Genus **CHEILEA** Modeer

Modeer, 1793, Kongl. Vetenskaps Academiens Nya Handlingar, vol. 14, pp. 110, 111.

Type species (by subsequent designation, Woodring, 1928, Carnegie Inst. Washington, Pub. 385, p. 374), *Patella equestris* Linné.

Cheilea cf. **equestris** (Linné)

A single, immature specimen (greatest diameter 8.1 mm) from Matura is available. Protoconch of about $1\frac{1}{2}$ whorls followed by a smooth area. Subsequent sculpture consists of fine radials with interspaces of about their own width. Growth somewhat irregular. Apex eccentric. Internal process with its lateral opening facing the slope opposite the steepest slope of the shell.

Fossil records of this widespread Recent species are rare. It

has been reported from the Pliocene of Florida by Dall [1890-1903 (1892), p. 348] and from the Bowden Formation of Jamaica by Woodring (1928, p. 375, pl. 30, figs. 1, 2).

Occurrence. — PJ 302.

Genus **CREPIDULA** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 78.

Type species (by monotypy), *Patella fornicata* Linné.

Subgenus **CREPIDULA** s. str.

Crepidula (Crepidula) cf. maculosa Conrad Pl. 47, figs. 8, 9

A single adult but incomplete specimen, from the Melajo Clay, is available. The apex is free, the protoconch consists of a little more than one volution. The deck is partly broken, but its insertion on the right side is preserved. Just in front of it there is a muscle scar which is typical for *C. maculosa* according to Stingley (1952, p. 84), who carefully compared this species with *C. fornicata*.

Specimens from the Savaneta Glauconitic Sandstone Member of the Springvale Formation are greatly inflated like the Melajo shell, thus looking similar to many of the Recent shells of *C. fornicata* at hand. However, none of them has the interior exposed. They have been identified as *C. fornicata* by Maury (1925, p. 244), Vokes (1938, p. 5), and Rutsch (1942, p. 103).

A number of immature specimens from the Melajo Clay and the Matura shell bed are listed as *Crepidula* sp.

Occurrence. — Hutch 51.

Crepidula plana Say Pl. 47, figs. 10, 11

1822. *Crepidula plana* Say, Acad. Nat. Sci. Philadelphia, Jour., 1st ser., vol. 2, p. 226.

1957. *Crepidula plana* Say, Woodring, U. S. Geol. Sur., Prof. Paper 306-A, p. 79, pl. 19, figs. 1-3. For further citations see this publication.

1961. *Crepidula (tanacus) plana* Say, Warmke and Abbott, Caribbean Seashells, p. 87, pl. 15 j.

1962. *Crepidula plana triangula* Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 212, pl. 19, figs. 11-13.

This species is represented by a few, mostly immature specimens from the Melajo Clay. Their protoconch which is appressed to the shell is still preserved and consists of almost $1\frac{1}{2}$ volutions. The shells are slightly convex or flat and are sculptured by more or less regular incrementals. Deck with an inconspicuous median elevation.

Weisbord described *C. plana triangulara* from the Pliocene Mare Formation of Venezuela. It is based on the holotype and one immature specimen. The differences from *C. plana s. str.* pointed out, e.g., the triangular shape and the overhanging anterior margin, can be observed in Recent specimens of *C. plana*.

Occurrence. — KR 11862, USGS 18399, USGS 18634.

Distribution. — Miocene to Recent (see Woodring, 1957, p. 79).

Subgenus **BOSTRYCAPULUS** Olsson and Harbison

Olsson and Harbison, 1953, Acad. Nat. Sci. Philadelphia, Mon. 8, p. 279.

Type species (by original designation), *Patella aculeata* Gmelin.

Crepidula (Bostrycapulus) aculeata (Gmelin)

1791. *Patella aculeata* Gmelin, Systema Naturae, ed. 13, p. 3693.

1864. *Crepidula aculeata* "Lamarck", Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.

1867. *Crepidula aculeata* "Lamarck", Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 160; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 39.

1874. *Crepidula aculeata* "Lamarck", Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 441.

1925. *Crepidula aculeata* Gmelin, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 243.

1953. *Crepidula (Bostrycapulus) aculeata* Gmelin, Olsson and Harbison, Acad. Nat. Sci. Philadelphia, Mon. No. 8, p. 280.

1961. *Crepidula aculeata* Gmelin, Warmke and Abbott, Caribbean Seashells, p. 86, pl. 15 i.

C. aculeata has been reported from Matura more than a century ago. The present collections contain only one immature specimen (length 6.5 mm). Its protoconch consists of $1\frac{1}{2}$ volutions and is appressed to the shell. The radial ribs are inconspicuous, because they are strongly worn. Maury reported specimens measuring up to 25 mm in length from Matura.

Occurrence. — JS 67.

Distribution. — Miocene (?) to Recent (see Weisbord, 1962, p. 215).

Genus **CALYPTRAEA** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 78.

Type species (by monotypy), *Patella chinensis* Linné.

Calyptraea centralis (Conrad)

1841. *Infundibulum centralis* Conrad, Amer. Jour. Sci., 1st ser., vol. 41, p. 348.

1867. *Trochita candeana* d'Orbigny, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 160; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 39.
1874. *Trochita candeana* d'Orbigny, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 440.
1910. *Trochita collinsii* Gabb, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 5; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 148.
1912. *Calyptraea centralis* Conrad, Maury, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 15, p. 100, pl. 13, fig. 6.
1925. *Calyptraea centralis* Conrad, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 243, pl. 43, fig. 2.
1938. *Calyptraea centralis* (Conrad), Vokes, Amer. Museum Novitates, No. 988, p. 5.
1942. *Calyptraea* cf. *centralis* (Conrad), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 103.
1947. *Calyptraea centralis* (Conrad), Gardner, U. S. Geol. Sur., Prof. Paper 142-H, p. 562, pl. 56, figs. 3, 4, 5. For additional citations see this publication.
1957. *Calyptraea centralis* (Conrad), Woodring, U. S. Geol. Sur., Prof. Paper 306-A, p. 80. For additional citations see this publication.

Type. — Missing according to Moore (1962, p. 47).

Type locality. — Natural Well, North Carolina (Duplin Fm.: late Miocene).

C. centralis occurs in the Melajo Clay, in the Courbaril beds, and at Matura. As pointed out by several authors Miocene specimens are larger than Recent shells, but they are usually considered as the same species. Specimens from the base of the Melajo Clay, the Courbaril beds, and Matura reach a diameter of up to 15 mm. But at the type locality of the Melajo Clay, where this species is represented by at least 200 shells, they have an average diameter of 6 to 7 mm.

The protoconch of this species consists of about $11\frac{1}{2}$ whorls. On many (but not all) specimens from the Melajo Clay there are fine concentric riblets on the last part of the protoconch. However, there are transitions from smooth to incremental lines to riblets which seem to indicate that this feature is not relevant taxonomically.

Occurrence. — Melajo River area: EL 1810, Hutch 47, KR 11862, K 9903, RR 290, PJ 285, USGS 18399, USGS 18411, USGS 21178. Point Courbaril: K 12255, PJ 212, USGS 10991, USGS 20432, USGS 20434. Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Trinidad: Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Cour-

baril beds of Upper Morne l'Enfer Fm., Matura shell bed. Outside Trinidad: Miocene to Recent, eastern United States to Caribbean (see Gardner and Woodring).

Genus **TROCHITA** Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, pp. 57, 184.

Type species (by subsequent designation, Rehder, 1943, Biol. Soc. Washington, Proc., vol. 56, p. 41), *Trochita spiralis* Schumacher (= *Trochus radians* Lamarck).

Trochita radians (Lamarck)

Pl. 47, figs. 12, 13

1816. *Trochus radians* Lamarck, Encyclopédie méthodique, Histoire naturelle des vers, vol. 3, pl. 445, figs. 3a, 3b; liste, p. 10.

1957. *Trochita trochiformis* (Born), Woodring, U. S. Geol. Sur., Prof. Paper 306-A, p. 81, pl. 19, figs. 11-14. For additional citations see this publication.

This species is represented from Matura by a few, mostly immature specimens. The protoconch, which is preserved on two specimens, consists of a little more than one volution. All the Matura fossils are relatively low-spined, and their radial sculpture fine.

According to Recent shells of *T. radians* at hand the coarseness of the radial sculpture is variable to some degree. The specimens from the middle Miocene of Panama figured by Woodring, and the shell recorded as *T. cf. radians* from the middle Miocene of Venezuela (Jung, 1965, p. 497, pl. 66, figs. 1, 2) have coarser radials. *T. floridana* Olsson and Petit (1964, p. 563, pl. 81, figs. 2, 2a) from the Neogene Pinecrest beds of Florida has much coarser radials with narrow interspaces.

The Matura specimens seem to be the youngest fossils of *Trochita* in the Caribbean region.

Occurrence. — RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Late Oligocene (?) to Recent (see Woodring, 1957, p. 82).

Genus **CRUCIBULUM** Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, pp. 56, 182.

Type species (by subsequent designation, Burch, 1946, Conchological Club Southern California, Proc., No. 56, p. 19), *Crucibulum planum* Schumacher (= *Patella auricula* Gmelin).

Subgenus **CRUCIBULUM** s. str.**Crucibulum (Crucibulum) subsutum** Guppy

Pl. 47, figs. 17-19

1864. *Crucibulum striatum* Say, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.
 1867. *Crucibulum subsutum* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 160, 172; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 39, 51.
 1874. *Crucibulum subsutum* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 435, 441, pl. 18, fig. 4.

Of medium size, solid, moderately high. Shell margin somewhat irregularly oval. Protoconch consists of a little more than one volution. First sculpture weak but rapidly increasing in strength; consists of low, rounded, and closely set, somewhat irregular radials. These radials tend to form groups of two, three, four, or even more which are separated from each other by broader and deeper interspaces. Margin of internal cup free.

Lectotype (herewith selected). — USNM 115612.

Dimensions of lectotype. — Height 12.7 mm, greatest diameter 24 mm.

Type locality. — Matura, Trinidad.

The type lot of this species consists of three specimens, two of which are immature. *C. subsutum* is not frequent at Matura. Guppy compared his species with *C. striatum* Say which ranges from Nova Scotia to South Carolina, but that species is a *Dispotaea* (see Abbott, 1951, p. 170, pl. 21 r). Immature specimens have part of their internal cup attached to the shell, and their sculpture is not yet developed typically.

There seems to be no species closely allied to *C. subsutum*. The sculpture of the lectotype is relatively weak compared with specimens from later collections and somewhat reminds *C. chipolanum* Dall [1890-1903 (1892), p. 319] from the Chipola Formation of Florida [Gardner, 1926-1950 (1917), p. 567, pl. 56, figs. 10, 11]. *C. chipolanum* has also been recorded from the middle Miocene Gatun Formation of the Panama Canal Zone by Woodring (1957, p. 82, pl. 19, figs. 6, 7). *C. auricula* (Gmelin) which ranges from middle Miocene to Recent (see Weisbord, 1962, p. 215) has a different aspect.

Occurrence. — JS 67, RR 230, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

Crucibulum (Crucibulum) piliferum Guppy

Pl. 47, figs. 14-16

1864. *Crucibulum tubifer* (J. de C. Sowerby), Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 35; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 15.
1867. *Crucibulum piliferum* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 160, 172; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 39, 51.
1874. *Crucibulum piliferum* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 435, 441.

Of medium size, thin-shelled, ranging in height from almost flat to moderately elevated. Base subcircular to somewhat irregularly oval. Protoconch consists of a little more than one volution, its axis strongly oblique to later axis. Protoconch followed by a smooth area of variable size. Sculpture consists of fine and closely set radials, some of which carry spines or even erect tubes at irregular intervals. Margin of internal cup free.

Lectotype (herewith selected). — USNM 115611.

Dimensions of lectotype. — Height 10.8 mm, greatest diameter 23 mm.

Type locality. — Matura, Trinidad.

The type lot of *C. piliferum* consists of three specimens, two of which are immature. The interior of the lectotype is concealed by hard matrix.

This species is well represented at Matura. Height and shape vary considerably. There seems to be no rule as to the development of spines; they may be numerous or almost lacking. They may be present near the apex already or be restricted to the margin. The internal cup of immature specimens is attached to the shell on one side but becomes free in adults.

C. piliferum evidently is related to the Recent West Coast *C. spinosum* (G. B. Sowerby II) which ranges from southern California to Chile according to Abbott (1954, p. 170). The collection of Recent *C. spinosum* at hand shows a variability similar to that of the Matura fossils. Specimens with only a few spines are not rare, and shells with reduced height are almost indistinguishable from analogue Matura specimens. *C. spinosum* has been recorded from the Esmeraldas Formation (late Miocene or early Pliocene) of Ecuador by Olsson (1964, p. 196, pl. 34, fig. 5). *C. piliferum* might eventually be treated as a synonym of *C. spinosum*, although the Recent species attains larger dimensions.

Immature specimens from the Courbaril beds and the Melajo Clay sometimes showing a few spines are identified as *C. cf. pili-ferum*.

Occurrence. — K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Known from type locality only.

Family ERATOIDAE

Genus ERATO Risso

Risso, 1826, *Histoire naturelle des principales productions de l'Europe méridionale*, vol. 4, p. 240.

Type species (by monotypy), *Voluta cypraeola* Brocchi.

Erato maugeriae Gray

Pl. 48, figs. 1, 2

1832. *Erato maugeriae* Gray, in G. B. Sowerby I, *Conch. Illustrations*, Cypraeidae, p. 15, pl. 7, fig. 47.
1861. *Erato* sp., Guppy, *Trans. Sci. Assoc. Trinidad* for 1864, p. 35; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, p. 15.
1867. *Erato maugeriae* Gray, Guppy, *Proc. Sci. Assoc. Trinidad*, pt. 3, p. 160; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, p. 39.
1874. *Erato maugeriae* Gray, Guppy, *Geol. Mag.*, new ser., decade 2, vol. 1, p. 440.
1953. *Erato maugeriae* Gray, Olsson and Harbison, *Acad. Nat. Sci. Philadelphia*, Mon. No. 8, p. 266, pl. 60, fig. 7. For additional citations see this publication.
1961. *Erato (Hespererato) maugeriae* Gray, Warmke and Abbott, *Caribbean Seashells*, p. 90, pl. 23 c.
1962. *Erato venezuelana* Weisbord, *Bull. Amer. Paleont.*, vol. 42, No. 193, p. 224, pl. 18, figs. 6, 7.

Small, stout, solid, with about $4\frac{1}{2}$ whorls including protoconch. Body whorl strongly inflated above, rapidly narrowing toward base. Spire low. Outer lip thick, denticulated, almost as high as apex. Inner lip with a varying number of inconspicuous denticles. A thin layer of callus spreads over the parietal region and some distance over the dorsal surface of the shell. Aperture long, widening at anterior canal.

This species is fairly well represented at Matura. The denticles of the outer lip may be weak in Recent specimens, but they remain fairly strong in Matura fossils. The prominence of the denticles on the inner lip is variable; part of them may be lacking at all.

E. venezuelana from the Pliocene Mare Formation of Venezuela is based on a single specimen which probably is not fully developed. The outer lip of a specimen from Matura is not thickened and slopes down from the suture instead of being strongly

shouldered. It has the same dimensions as the holotype of *E. venezuelana* and looks like it. These two specimens have an "unfinished" appearance, although there are even smaller shells showing the features of adults.

E. domingensis Maury (1917, p. 118, pl. 21, fig. 8) from the Cercado Formation of the Dominican Republic is a smaller species with only three whorls including the protoconch. It is easily separable from *E. maugeriae* by its prominent, longitudinal ridge on the columella which is followed toward the interior by a concave area, and the lack of denticles on the inner lip. *E. domingensis trochala* Woodring (1928, p. 321, pl. 22, fig. 12), from the Bowden Formation of Jamaica, is also smaller than *E. maugeriae*. It has a weak longitudinal ridge on the columella in front of a shallowly concave area carrying a few denticles on its lower part.

Occurrence. — JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Miocene (?), Pliocene to Recent (see Weisbord, 1962, p. 225).

Genus **TRIVIA** Broderip

Broderip, 1837, Penny Cyclopaedia, vol. 8, p. 256.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 142), *Cypraea europaea* Montagu.

Subgenus **PUSULA** Jousseaume

Jousseaume, 1884, Soc. Zool. France, Bull., vol. 9, p. 99.

Type species (by subsequent designation, Roberts, 1885, in Tryon's Manual of Conchology, vol. 7, p. 161), *Cypraea radians* Lamarck.

Trivia (Pusula) radians orientalis (Schilder) Pl. 48, figs. 3-5

1939. *Pusula (Pusula) radians orientalis* Schilder, Abh. Schweiz. Pal. Ges., vol. 62, p. 11, text figs. 2, 3.

Holotype. — Natural History Museum Basel, No. H 11228.

Dimension of holotype. — Length 17.1 mm.

Type locality. — Matura, Trinidad.

This form is based on two fragments. The holotype consists of the inner lip and part of the anterior dorsal surface showing part of the dorsal furrow with some adjoining pustules. The only paratype has the inner and outer lips preserved, but not the dorsal surface.

These fragments make a comparison with the Recent West Coast *T. radians* (Lamarck) unsatisfactory. Better specimens from Matura might prove to be conspecific with *T. radians*, because the differences pointed out by Schilder seem to fall within the variability of *T. radians*.

Occurrence. — Matura, Trinidad.

Distribution. — Known from type locality only.

Family CYPRAEIDAE

Genus CYPRAEA Linné

Linné, 1758, *Systema Naturae*, ed. 10, p. 718.

Type species (by subsequent designation, Montfort, 1810, *Conchyliologie systématique*, vol. 2, p. 631), *Cypraea tigris* Linné.

Cypraea species

Pl. 48, figs. 6, 7

Three immature specimens from Matura are available. The last whorl is moderately inflated, the outer lip not yet thickened. The apex is sunken, but the three-whorled protoconch rises from the middle of this depressed area.

Olsson and Petit (1964, pp. 556-561) discussed some species from the Neogene of Florida and the Carolinas. They gave generic rank to *Siphocypraea* Heilprin (1887, p. 86), type species by monotypy: *Cypraea problematica* Heilprin (Pliocene, Florida), stating that *Siphocypraeas* differ from other *Cypraeas* in having a depressed spire in juvenile stages. However, the same feature is shown by the Recent Western Pacific *C. tigris* Linné, the type species of *Cypraea*, and by immature specimens of the Recent southern Caribbean *C. mus* Linné which is the type species of *Muracypraea* Woodring (1957a, p. 88). Members of these supraspecific categories can be identified only, if adult specimens are available.

Comparison of the Matura specimens with shells of the corresponding growth stage of *C. problematica* and *C. mus* shows that they are intermediate in characters. The general outline of the Matura fossils is much like that of *C. mus*, whereas immature *C. problematica* is more slender, and its outer lip is arched upwards posteriorly producing a more deeply depressed area than in *C. mus* or the Matura shells. On the other hand the protoconch of *C. problematica* rises considerably above the surface of the depressed area as in the Matura specimens, whereas in *C. mus* this is the case to a lesser extent only.

Besides the three immature shells there is an adult specimen from Matura (height 55 mm). Its inner and outer lips are preserved, but not the dorsal surface. It is uncertain whether it is the adult of the immature form mentioned above or some other species. It lacks the flanges bordering the anterior canal which are typical in *C. mus*, and looks unlike any living Caribbean species. Its poor state of preservation leaves affinities to other species uncertain.

Occurrence. — RR 230, USGS 18204.

Subgenus **EROSARIA** Troschel

Troschel, 1863, *Das Gebiss der Schnecken zur Begründung einer natürlichen Classification*, vol. 1, p. 205.

Type species (by subsequent designation, Jousseaume, 1884, *Bull. Soc. Zool. France*, vol. 9, p. 96), *Cypraea erosa* Linné.

Cypraea (Erosaria) aliena (Schilder) Pl. 48, figs. 8-10

1939. *Erosaria (Ravitrona) aliena* Schilder, *Abh. Schweiz. Pal. Ges.*, vol. 62, p. 20, text fig. 20.

1947. *Cypraea aliena* (Schilder), Ingram, *Bull. Amer. Paleont.*, vol. 31, No. 122, p. 7.

Holotype. — Natural History Museum Basel, No. H 11263.

Dimensions of holotype. — Height 15 mm, greatest diameter 9.7 mm.

Type locality. — Matura, Trinidad.

This species is known from the holotype only. As pointed out by Schilder it is related to the Recent Caribbean *C. spurca acicularis* Gmelin as well as to the Recent West Coast *C. albuginosa* Gray. The type of *C. aliena* is somewhat worn, part of its spire is visible, but it lacks any remains of colour patterns. It does not seem to be entirely adult, and additional specimens might show that it represents one of the above mentioned Recent species.

Occurrence. — Matura, Trinidad.

Distribution. — Known from type locality only.

Family **OVULIDAE**

Genus **NEOSIMNIA** Fischer

Fischer, 1884, *Manuel de Conchyliologie*, p. 664.

Type species (by monotypy), *Bulla spelta* Linné.

Neosimnia cf. uniplicata (G. B. Sowerby II) Pl. 48, figs. 11, 12

Of medium size, stout. Outer lip somewhat thickened. Parietal

callus prominent. There is a longitudinal ridge on the columella within the aperture with a slightly concave area in front of it, and a spiral ridge on the posterior end of the columella. Sculpture consists of fine growth lines and a few spiral grooves at each end of the shell.

This form is represented by a single shell (height 10.2 mm) from Matura. It is considerably smaller than the Recent *N. uniplicata* (G. B. Sowerby II) (Thes. Conch., pt. 9, p. 478, pl. 100, figs. 30, 31, 32, 1848; Zool. Soc. London, Proc., pt. 16, p. 135, 1849) which ranges from Virginia to Florida and the West Indies according to Warmke and Abbott (1961, p. 92). *N. uniplicata* shows some variability as to stoutness and size. The fine spiral striation covers the entire body whorl in young stages, but is restricted to the ends in adults as stated by Dall (1889 a, p. 236) which suggests that the Matura shell is adult.

A similar species is *N. immunita* (Guppy) (1873a, p. 78, pl. 1, fig. 7), from the Bowden Formation of Jamaica, which has been redescribed by Woodring (1928, p. 315, pl. 21, figs. 3-8). Bowden specimens, with dimensions similar to those of the Matura shell, are somewhat more slender, the posterior spiral plication is less pronounced, and the aperture narrower. Woodring suggested that *N. wisewoodae* (Maury) (1917, p. 113, pl. 22, fig. 17) from the middle Miocene Cercado Formation of the Dominican Republic might be a synonym of *N. immunita*.

Occurrence.—USGS 18204.

Family **NATICIDAE**

Genus **NATICA** Scopoli

Scopoli, 1777, *Introductio ad historiam naturalem*, p. 392.

Type species (by subsequent designation, Harris, 1897, *Catalogue of Tertiary Mollusca in the British Museum*; pt. 1, Australasian, p. 255), *Nerita vitellus* Linné.

Subgenus **NATICARIUS** Duméril

Duméril, 1806, *Zoologie analytique* . . ., p. 164.

Type species (by monotypy), *Nerita canrena* Linné. See Iredale, *Malac. Soc. London, Proc.*, vol. 12, p. 83, 1916.

Natica (Naticarius) canrena (Linné)

1758. *Nerita canrena* Linné, *Systema Naturae*, ed. 10, p. 776.

1867. *Natica canrena* Linné, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 156; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 35.
1874. *Natica canrena* Linné, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 437.
1910. *Natica canrena* Linné, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 5; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 148.
1925. *Natica canrena* (Linnaeus), Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 238, pl. 40, fig. 8.
1925. *Natica canrena* (Linnaeus), Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 57.
1938. *Natica* (*Naticarius*) *canrena* Mörch, Vokes, Amer. Museum Novitates, No. 988, p. 5.
1942. *Natica* (*Naticarius*) *canrena* (Linné), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 103.
1962. *Natica* (*Naticarius*) *canrena* (Linnaeus), Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 244, pl. 23, figs. 1, 2. For additional citations see this publication.

This species is represented by a few shells from the Melajo Clay. As stated elsewhere (Jung, 1964) the most diagnostic features of species belonging to the group of *N. canrena* are the size of the shell, the size of the initial whorl, and the number of nuclear whorls. The protoconch of the Melajo specimens consists of a little more than two whorls like that of specimens from Springvale Quarry. The initial whorl is somewhat smaller than that of Recent shells.

Occurrence. — Hutch 51, USGS 18411, USGS 18634.

Distribution. — Miocene to Recent (see Weisbord, 1962, p. 246).

***Natica* (*Naticarius*) aff. *canrena* (Linné)**

Pl. 48, figs. 13, 14

Of medium size, with about two nuclear volutions and up to $3\frac{1}{2}$ postnuclear whorls. Initial whorl small. Spire high. Sculpture consists of proscline wrinkles on upper part of whorl. Funicle small.

This form is abundant in the Melajo Clay and the Courbaril beds but much less so at Matura. Although the height of the spire usually is a variable feature, this form has a consistently higher spire than *N. canrena*. It does not reach the dimensions of *N. canrena*, and its initial whorl is much smaller. Although Guppy cited *N. canrena* from Matura, the present Matura shells are provisionally identified as *N. aff. canrena*.

Some specimens from the Courbaril beds reach a larger size than those from the Melajo Clay. They are more inflated and resemble *N. stenopa* Woodring (1957, p. 85, pl. 20, figs. 4-6) from

the upper part of the Gatun Formation of the Panama Canal Zone. However, *N. stenopa* has more nuclear whorls. The figured specimen from the Courbaril beds (Pl. 48, fig. 13) has a somewhat everted basal lip.

The specimens from the Melajo Clay probably are immature. They have a slender appearance as their whorls are not much inflated. They are identical with Courbaril specimens of the same size.

Occurrence.—Melajo River area: Hutch 47, Hutch 51, KR 11862, K 9797, K 9813, K 9816, K 9903, PJ 285, USGS 18399, USGS 18634, USGS 21178. Point Courbaril: K 1429, K 8399, K 12013, K 12255, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778. Matura Bay: JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Genus **TECTONATICA** Sacco

Sacco, 1890, Mus. Zool. Anat. Comp. R. Univ. Torino, Bol., vol. 5, No. 86, p. 33.

Type species (by monotypy), *Natica tectula* Bonelli.

Tectonatica pusilla (Say)

Pl. 48, fig. 15

1822. *Natica pusilla* Say, Acad. Nat. Sci. Philadelphia, Jour., 1st ser., vol. 2, pt. 2, p. 257.
 1928. *Tectonatica pusilla* (Say), Woodring, Carnegie Inst. Washington, Pub. 385, p. 384, pl. 30, fig. 12. For further citations see this publication.
 1930. *Tectonatica pusilla* (Say), Mansfield, Florida State Geol. Sur., Bull. No. 3, p. 123, pl. 19, fig. 4. For further citations see this publication.
 1953. *Tectonatica pusilla* (Say), Olsson and Harbison, Acad. Nat. Sci. Philadelphia, Mon. No. 8, p. 269, pl. 57, figs. 4, 4a.
 1961. *Tectonatica pusilla* Say, Warmke and Abbott, Caribbean Seashells, p. 97, pl. 17 d.

Small, inflated, solid, with about four whorls. Suture clearly incised. Surface smooth except for growth lines. Parietal callus thick, continuous into the umbilicus which it completely fills leaving a prominent groove along the umbilical margin.

This species is represented from Matura by about 20 specimens. Although not recorded, it occurs in the Savaneta Glauconitic Sandstone Member of the Springvale Formation, but it has not been found in the Melajo Clay nor in the Courbaril beds. The spire of most of the Matura shells is low. Recent specimens show a considerable variability in this respect.

T. venezuelana Weisbord (1962, p. 248, pl. 23, figs. 5, 6), from

the Pliocene Mare Formation of Venezuela, is said to have 3½ whorls and possibly represents immature, low-spired *T. pusilla*. *T. antilleana* Weisbord (1962, p. 249, pl. 43, figs. 22, 23), also from the Pliocene of Venezuela, is based on a single, incomplete specimen, and is virtually unrecognizable. *T. agna* Woodring (1957, p. 88, pl. 17, fig. 46), from the middle and upper parts of the Gatun Formation of the Panama Canal Zone (middle and late Miocene), is said to differ from *T. pusilla* by its "more distinct depression on the umbilical callus lobe and the narrower groove at the outer edge of the lobe." The depression is not always present in Recent shells of *T. pusilla*, and the prominence of the groove around the umbilical callus is variable. But the numerous topotypes of *T. agna* at hand are consistently smaller than *T. pusilla*.

Occurrence.—JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution.—Cercado and Gurabo Formations (middle Miocene), Dominican Republic. Bowden Formation, Jamaica. Upper Miocene, Florida, Trinidad. Pliocene, South Carolina, Florida, Venezuela (?). Living, Eastern United States, Gulf States, and West Indies.

Genus **POLINICES** Montfort

Montfort, 1810, *Conchyliologie systématique*, vol. 2, p. 223.

Type species (by original designation), *Polinices albus* Montfort (= *Natica mamillaris* Lamarck = *Natica brunnea* Link = *Albula hepatica* Röding).

Polinices stanislasmeunieri Maury Pl. 48, figs. 16-18

1917. *Polinices stanislas-meunieri* Maury, *Bull. Amer. Paleont.*, vol. 5, No. 29, p. 136, pl. 23, figs. 15, 16.

1925. *Polinices stanislas-meunieri* Maury, Maury, *ibidem*, vol. 10, No. 42, p. 240, pl. 40, fig. 7.

1925. *Polinices caparona* Maury, *ibidem*, p. 241, pl. 40, fig. 6.

1925. *Polinices springualensis* Maury, *ibidem*, p. 241, pl. 40, fig. 6.

1938. *Polinices stanislas-meunieri* Maury, and *Polinices springualensis* Maury, Vokes, *Amer. Museum Novitates*, No. 988, p. 5.

1942. *Polinices (Dallitesta) stanislaus-meunieri* Maury, and *Polinices (Dallitesta) stanislas-meunieri springualensis* Maury, Rutsch, *Verh. Naturf. Ges. Basel*, vol. 54, p. 103.

1957. *Polinices stanislas-meunieri* Maury, Woodring, *U. S. Geol. Sur., Prof. Paper 306-A*, p. 90, pl. 21, figs. 11-14. For additional citations see this publication.

Of medium to large size. Protoconch consists of about two whorls. Postnuclear whorls 4½. Spire moderately high. Body whorl

strongly inflated and mostly somewhat shouldered. Spiral lineation fine, but well recognizable on unworn specimens. Parietal callus heavy. Umbilical callus small; umbilical opening usually small, but somewhat variable in size.

Type. — Cornell University, Paleont. Museum, Ithaca, N. Y., No. 36931.

Type locality. — Río Cana, Dominican Republic (middle Miocene).

This species occurs in the Melajo Clay and is represented by well over 100 specimens. They show that *P. stanislasmeunieri* is a strongly variable species in several respects: height of the spire, inflation of body whorl, prominence of shoulders, and size of umbilical opening.

P. caparonus Maury from the middle Miocene Manzanilla Formation of Trinidad is considered to represent this species. The largest Melajo shells reach the dimensions of Maury's type specimen. *P. subangulatus* Nelson (1870, p. 195, pl. 6, figs. 12, 13; not fig. 4) from the Miocene Tumbes Formation of Peru is also a variable species according to Olsson (1932, p. 209, pl. 24, figs. 1, 2). Paratypes and topotypes of *P. subangulatus* at hand show that it tends to have a heavier shell; its shoulders may reach a prominence which is never attained by Melajo specimens. The relations to other species have been discussed by Woodring (1957, pp. 90-91).

Occurrence. — EL 1810, Hutch 51, KR 11862, K 9797, K 9902, K 9903, RR 290, PJ 285, USGS 18399, USGS 18634, USGS 21178.

Distribution. — Middle to late Miocene in the Caribbean region (see Woodring, 1957, p. 91).

Polinices species

The genus *Polinices* is represented from Matura by a single, somewhat worn, immature shell (height 16.2 mm, diameter 13.8 mm). It consists of $4\frac{1}{2}$ whorls including the protoconch. Its spire is low, the parietal callus heavy, and the umbilical opening relatively large. Umbilical callus small, forming a right angle with the lower margin of the parietal callus.

The specific affinities of this immature shell are uncertain, although immature specimens of the Recent Eastern Pacific *P. uber* (Valenciennes) contained in the collections of the U. S. National Museum closely resemble it.

Occurrence. — RR 230.

Family **CYMATIIDAE**

Genus **CYMATIUM** Röding

Röding, 1798, in *Museum Boltenianum*, p. 129.

Type species (by subsequent designation, Dall, 1904, *Smithsonian Misc. Coll.*, vol. 47, No. 1475, p. 133), *Cymatium femorale* Röding (= *Murex femorale* Linné).

Cymatium species

A single, immature shell (height 25.4 mm) from the base of the Melajo Clay is available. The protoconch is missing; 4½ whorls are preserved. Early sculpture consists of five spirals with wider interspaces which are crossed by inconspicuous axials numbering about 16 on early whorls. Subsequent whorls are shouldered a little above the middle. The shoulder carries prominent nodes (nine on last preserved whorl). Siphonal canal long, bent backwards. Columella with numerous denticles.

The Melajo specimen is too immature even for subgeneric assignment. Rutsch (1942, p. 143, pl. 9, fig. 5) described *C. kugleri* from Springvale Quarry, but that species has a shorter spire, an inconspicuous shoulder, and a more inflated body whorl.

Occurrence. — USGS 18634.

Genus **COLUBRARIA** Schumacher

Schumacher, 1817, *Essai d'un nouveau système des habitations des vers testacés*, p. 251.

Type species (by monotypy), *Colubraria granulata* Schumacher.

Colubraria species

A single fragment from the base of the Melajo Clay, consisting of the protoconch and four sculptured whorls, is available. The protoconch has a little more than 2½ whorls. Initial whorl small and planispiral, but subsequent whorls rapidly enlarging and trochospiral. Early sculpture reticulate, consisting of six spirals which are crossed by numerous, somewhat opisthoclinal axials. On subsequent whorls secondary spirals are intercalated. There are two varices per whorl.

The shape of the protoconch and the early sculpture suggest a relationship with the Recent West Indian *C. lanceolata* (Menke)

(Synopsis methodica Molluscorum . . . , p. 87, 1828). The protoconch of *C. lanceolata* has been figured by Campbell (1961, p. 138, fig. 3). *C. lanceolata*, however, has less, but stronger varices than the Melajo specimen.

Occurrence. — USGS 18411.

Family **BURSIDAE**

Genus **BURSA** Röding

Röding, 1798, in Museum Boltenianum, p. 128.

Type species (by subsequent designation, Jousseaume, 1881, Soc. Zool. France, Bull., vol. 6, p. 174), *Bursa mammata* Röding (= *Murex bufonius* Gmelin).

Subgenus **BURSA** s. str.

Bursa (Bursa) aff. thomae (d'Orbigny) Pl. 49, figs. 1, 2

Of medium size. Protoconch consists of $3\frac{1}{2}$ inflated, rapidly enlarging whorls. Postnuclear whorls a little more than four. Early sculpture consists of six beaded spirals which start abruptly. The fourth spiral from the upper suture is stronger and develops into a prominent shoulder subsequently. Varices two per whorl, almost alined on successive whorls, forming a sigmoid curve, when viewed from top. Shoulder of later whorls with two prominent knobs between varices. Spirals above shoulder weak. Body whorl with two spirals below shoulder which are prominent near the varices only. Their interspaces with weak, additional spirals. Inner lip with many elongate denticles. Outer lip with four pairs of denticles; their position corresponds externally to the interspaces of the spirals. Anterior canal bent backwards. Posterior canal well separated from parietal wall. Posterior canals of earlier stages visible after each varix.

This form is represented by a single, well-preserved shell from the base of the Melajo Clay. According to Morrison (1949, p. 11) the Recent *B. thomae* (d'Orbigny) (1845, p. 250; Atlas, pl. 23, fig. 23, 1842) which has been redescribed by Abbott (1958, p. 56, text fig. 1, pl. 1 j) is the only species of *Bursa* s. str. in the Western Atlantic. *B. thomae* also occurs in the Eastern Atlantic and the Indo-Pacific according to these authors.

B. thomae is represented in the collections of the U. S. National Museum by a few specimens only, and its variability is not well

known. The smaller apical angle and the almost complete lack of sculpture above the shoulder separate the Melajo shell from that species. Two topotypes of *B. bufoniopsis* Maury (1917, p. 108, pl. 17, fig. 8), from the middle Miocene Gurabo Formation of the Dominican Republic, are at hand. They have stronger sculpture above the shoulder than *B. thomae*, but are certainly closely related to the Recent species.

Occurrence. — USGS 18634.

Subgenus **MARSUPINA** Dall

Dall, 1904, Smithsonian Misc. Coll., vol. 47, No. 1475, p. 118.

Type species (by original designation), *Bufo spadiceus* Montfort (= *Murex crassus* Dillwyn = *Murex bufo* Bruguière).

Bursa (Marsupina) bufo (Bruguière) Pl. 49, figs. 3-6

1792. *Murex bufo* Bruguière, Actes Soc. Hist. Nat. Paris, vol. 1, p. 126. Cayenne, French Guiana. Refers to Martini-Chemnitz, Neues systematisches Conchylien-Cabinet, vol. 4, p. 106, pl. 133, figs. 1272, 1273, 1780.
1810. *Bufo spadiceus* Montfort, Conchyliologie systématique, vol. 2, p. 575. Refers to Martini-Chemnitz, Neues syst. Conchylien-Cabinet, vol. 4, pl. 128, figs. 1233, 1234 (error ?). Montfort's illustration represents *B. bufo*.
1816. *Ranella granulata* Lamarck, Tableau encyclopédique et méthodique, pl. 412, figs. 4a, 4b. Liste, p. 4.
1817. *Murex crassus* Dillwyn, A descriptive catalogue of Recent shells, vol. 2, p. 692. Refers to Martini-Chemnitz, Neues syst. Conchylien-Cabinet, vol. 4, p. 106, pl. 133, figs. 1272, 1273.
1961. *Bursa (Bufonaria) spadicea* Montfort, Warmke and Abbott, Caribbean Seashells, p. 103, pl. 18 1.

Of medium to large size. Protoconch with $3\frac{1}{2}$ smooth, rapidly enlarging volutions. Postnuclear whorls numbering up to more than five. First sculpture starting abruptly, consists of four spirals and fine axials which cause beads at the intersections. First varix appearing after a little more than half a whorl. Later varices practically aligned on successive whorls. First and fourth spiral from upper suture have more prominent beads; the fourth one develops into a shoulder. Shoulder of late whorls inconspicuous or even absent. Inner and outer lips with numerous denticles. Anterior canal slightly bent backwards. Inner wall of posterior canal formed by penultimate whorl. Former posterior canals visible after each varix.

This species is represented from Matura by a few specimens only. One of them (Pl. 49, figs. 5, 6) is exceptionally large (height 75 mm). It is strongly compressed and has no shoulder on the body

whorl. Immature specimens have a different appearance; they look stouter, and their whorls are shouldered.

The granulation of the spirals of *Matura* specimens is somewhat coarser than that of Recent shells. The collections of the U. S. National Museum contain specimens, the late whorls of which have obsolete spiral sculpture, but a pronounced shoulder carrying one heavy knob between two varices. Shells with granulated spirals do not have this knob. Only large collections can show, whether these forms are connected by transitions or not.

Several names have been proposed for the Miocene representatives of this species. According to Morrison (1949, p. 11) they all represent the Recent species. The Recent species has been cited as *Bursa crassa* Dillwyn from the middle Miocene of the Dominican Republic (Maury, 1917, p. 108, pl. 17, figs. 6, 7), Costa Rica (Olsson, 1922, p. 134, pl. 15, fig. 19), Jamaica (Guppy, 1866a, p. 288, pl. 18, fig. 9), and Trinidad (Maury, 1925 p. 217). For some of these records subspecific names have been proposed: *proavus* Pilsbry (1922, p. 360, pl. 29, figs. 4, 5) for the records from the Dominican Republic, *bowdenensis* Pilsbry (1922, p. 360, pl. 29, fig. 8) for the Jamaican record, and *colombiana* Weisbord (1929, p. 41, pl. 8, figs. 1, 2) for specimens from the middle Miocene of Columbia (see also Barrios, 1960, p. 277, pl. 9, figs. 4, 5). Several of the identifications mentioned above are based on immature specimens, and these are practically indistinguishable from Recent immature shells. However, all the Miocene specimens have somewhat coarser granulation than Recent ones. Adult shells from Bowden, Jamaica, at hand (see also Woodring, 1928, p. 303, pl. 19, fig. 4) have coarse granulation and one or more conspicuous nodes on the shoulder between two varices, a combination never occurring in Recent shells.

Whether *B. freya* Olsson (1932, p. 187, pl. 21, figs. 3, 4, 6) from the late Oligocene or early Miocene of Peru represents a distinct species cannot be decided without topotypes.

I am indebted to Dr. J. P. E. Morrison of the Division of Mollusks, U. S. National Museum, for calling my attention to Bruguière's name.

Occurrence. — RR 230, USGS 18204, USGS 19860.

Distribution. — Recent: southeastern Florida and West Indies.

Family **TONNIDAE**Genus **MALEA** Valenciennes

Valenciennes, 1832, in Humboldt and Bonpland, Voyage aux régions équinoxiales du nouveau continent; Recueil d'observations de zoologie et d'anatomie comparée, vol. 2, p. 324.

Type species (by subsequent designation, Hermannsen, 1847, Indicis generum malacozoorum, vol. 2, p. 13), *Malea latilabris* Valenciennes (= *Cassis ringens* Swainson).

Malea species

Two fragments from the Melajo Clay, representing parts of the outer lip, are at hand. They have strong teeth which tend to be dichotomous toward the outer margin. The external surface shows some flat spirals with narrower interspaces. Some of the interspaces have secondary spirals. The larger fragment representing the lower part of the outer lip is 37 mm high and suggests that the entire shell must have reached a height of about 100 mm.

The fragments are insufficient to point out specific affinities. The widespread *M. camura* Guppy (1866a, p. 287, pl. 17, fig. 9) has been rediscussed by Woodring (1959, p. 208, pl. 33, figs. 1-1), and the late Miocene *M. densecostata* (Rutsch) (1934, p. 60, pl. 3, figs. 6, 7) by Olsson and Petit (1964, p. 554, pl. 79, figs. 5, 5a).

Occurrence. — USGS 21178.

Family **MURICIDAE**Genus **MUREX** Linné

Linné, 1758, Systema Naturae, ed. 10, p. 746.

Type species (by subsequent designation, Montfort, 1810, Conchyliologie systématique, vol. 2, p. 619), *Murex pecten* Montfort (= *Murex tribulus* Linné).

Subgenus **MUREX** s. str.

Murex (Murex) chrysostoma G. B. Sowerby I Pl. 49, figs. 8-10

1834. *Murex chrysostoma* "Gray" G. B. Sowerby I, Conchological Illustrations, pl. 58, fig. 1.

1945. *Murex (Murex) chrysostoma* Sowerby, Clench and Pérez Farfante, Johnsonia, vol. 1, No. 17, p. 10, pl. 5, figs. 1, 2.

1962. *Murex (Murex) chrysostomus* Sowerby, Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 282, pl. 25, figs. 17, 18. For further citations see this publication.

1963. *Murex (Murex) chrysostomus* Sowerby, Vokes, Tulane Studies in Geology, vol. 1, No. 3, p. 109, pl. 4, figs. 9a, 9b.

Of medium size. Protoconch consists of $11\frac{1}{2}$ smooth whorls. First sculpture, which starts abruptly, with four spirals and numerous axials causing beads at the intersections. Subsequently the axials become much more prominent than the spirals. Varices three per whorl, the first one appearing on the third postnuclear whorl. There are two or three intervarical axials of varying strength which are most prominent on the shoulder of the whorl. Aperture subcircular. Outer lip with numerous, long denticles; inner lip with similar denticles, but the uppermost one stronger. Lower part of inner lip detached from parietal wall. Anterior canal moderately long. Body whorl with numerous, inconspicuous spirals which usually alternate in size.

This species is represented by a few specimens from the base of the Melajo Clay. None of them has a complete anterior canal. The varices sometimes carry a short, hollow spine on the shoulder which is the case in some Recent shells. Recent specimens have one to three intervarical axials. Generally the first axial after a varix is stronger than the others which is also true for the Melajo specimens.

M. polynematicus Brown and Pilsbry (1911, p. 353, pl. 26, fig. 1), from the middle Miocene Gatun Formation of the Panama Canal Zone, has more strongly shouldered whorls, less intervarical axials, more spirals, and lacks denticles on the upper part of the inner lip. Woodring (1959, p. 215, pl. 36, figs. 2, 3, pl. 37, figs. 6, 9) compared *M. polynematicus* with *M. chrysostoma* but stated that they are not closely related. According to Vokes (1965, p. 183) *M. polynematicus* belongs to the subgenus *Siratus*.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Pliocene, Venezuela. Recent, southern Caribbean region (one record from the Bahamas in the collections of the U. S. National Museum).

Subgenus **PHYLLONOTUS** Swainson

Swainson, 1833, Zoological Illustrations, ser. 2, vol. 3, pl. 109.

Type species (by monotypy) *Murex (Phyllonotus) imperialis* var. a = *Murex (Phyllonotus) margaritensis* Abbott (1958, p. 61, pl. 1 n and o). See also Keen, Nautilus, vol. 73, No. 3, p. 105, 1960.

***Murex (Phyllonotus) cf. pomum* Gmelin**

Two fragmentary specimens from the base of the Melajo Clay

and one shell from Matura suggest *M. pomum*. The larger specimen from the Melajo Clay is 93 mm high, and is encrusted by oysters and vermetids. It has $4\frac{1}{2}$ varices, whereas the Matura shell has only three. They both have only one axially elongated node between the varices.

M. pomum has been recorded from middle Miocene to Recent (see Weisbord, 1962, p. 288).

Occurrence.—Melajo River area: USGS 18634. Matura Bay: RR 230.

Subgenus **CHICOREUS** Montfort

Montfort, 1810, Conchyliologie systématique, vol. 2, p. 611.

Type species (by monotypy), *Chicoreus ramosus* Montfort (= *Murex brevifrons* Lamarck).

Murex (Chicoreus) cf. brevifrons Lamarck

Pl. 49, fig. 7

One immature shell from the base of the Melajo Clay and several, mostly fragmentary specimens from the Courbaril beds, are too incomplete or worn for positive identification. Most of the spines are broken or strongly worn which makes the recognition of the subtle differences between *M. brevifrons* and the Miocene *M. cornurectus* Guppy (1876, p. 521, pl. 28, fig. 4) from the Dominican Republic as indicated by Vokes (1965, p. 193) impossible.

Vokes (1965) accepted Pliocene records of *M. brevifrons* but rejected Miocene ones, whereas Woodring (1959, p. 216) synonymized *M. cornurectus* and *M. venezuelanus* F. Hodson (in Hodson and Hodson, 1931a, p. 37, pl. 18, fig. 1, pl. 19, figs. 1, 3) from the middle Miocene of Falcón, Venezuela, with *M. brevifrons*.

Occurrence.—Melajo River area: USGS 18634. Point Courbaril: K 12255, USGS 10991, USGS 20432a, USGS 21778.

Genus **EUPLEURA** H. and A. Adams

H. and A. Adams, 1853, The Genera of Recent Mollusca, vol. 1, p. 107.

Type species (by subsequent designation, Baker, 1895, Chicago Acad. Sci., Bull., vol. 2, p. 176), *Ranella caudata* Say.

Eupleura lehneri, n. sp.

Pl. 50, figs. 1-4

Of small to medium size. Protoconch consists of two smooth whorls; initial whorl small. Postnuclear whorls numbering up to seven. Early sculpture consists of two spirals and numerous axials (about 14 on first sculptured whorl). The upper spiral forms a

prominent shoulder on the first sculptured whorl already. Number of axials decreases rapidly on later whorls, but they become more and more lamellar. First varix usually appears on the penultimate whorl only. Later varices are almost directly opposite the earlier ones. Intervarical axials three but reduced to broad nodes on the shoulder or even become obsolete. Body whorl moderately inflated. Last varix with six spines which are grooved anteriorly. The uppermost one is larger than the others and is pointing steeply upwards. Body whorl with spirals corresponding to the spines. Outer lip with denticles corresponding to the interspaces of the spines. Inner lip smooth. Aperture subtriangular, most acute angle pointing toward base. Siphonal canal moderately long, straight, not bent backward.

Holotype. — USNM 645346.

Dimensions of holotype. — Height 27 mm, diameter (including spines) 19.6 mm.

Type locality. — Melajo River area: USGS 21178.

E. lehneri occurs in the Melajo Clay and is represented by five adult specimens and numerous fragments and immature specimens.

E. lehneri is closely related to the Recent Eastern Pacific *E. muriciformis* (Broderip) (in Broderip and G. B. Sowerby 1, 1832-1833, p. 179, 1833; Hertlein and Strong, 1955, p. 258) which has also been reported from the Pliocene of western Ecuador by Pilsbry and Olsson (1941, p. 37). The numerous Recent shells of *E. muriciformis* at hand are consistently larger and more slender than *E. lehneri*. They have a higher spire, their uppermost spine on the last varix is less steep, and their siphonal canal is slightly bent backward, whereas in *E. lehneri* it is straight.

The single specimen from the middle Miocene Angostura Formation of western Ecuador described by Olsson (1964, p. 139, pl. 29, fig. 9) as *E. thompsoni* Woodring subspecies has about the same dimensions as *E. lehneri*. Its siphonal canal is slightly bent backward, and there are four nodes on the shoulder between the last two varices.

E. thompsoni Woodring (1959, p. 218, pl. 36, figs. 6-9), from the middle Miocene Gatun Formation of the Panama Canal Zone, is a considerably larger species with more inflated whorls. It has a larger apical angle and much less projecting varices than *E.*

lehneri. *E. kugleri* Jung (1965, p. 524, pl. 70, figs. 3-6) from the middle Miocene of the Paraguaná Peninsula, Venezuela, has also much less prominent varices but more spines on the last varix.

Occurrence. — EL 1810, Hutch 47, Hutch 51, K 9903, PJ 285, USGS 18399, USGS 21178.

Genus **TYPHIS** Montfort

Montfort, 1810, *Conchyliologie systématique*, vol. 2, p. 615.

Type species (by original designation), *Purpura tubifer* Bruguière.

Subgenus **TYPHINELLUS** Jousseaume

Jousseaume, 1880, *Le Naturaliste*, deuxième année, vol. 1, No. 42, p. 335.

Type species (by original designation), *Typhis sowerbiyi* Broderip (= *Typhis sowerbyii* Broderip).

Typhis (Typhinellus) cf. quadratus Hinds Pl. 50, figs. 5, 6

‡1867. *Typhis alatus* Sowerby, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 157; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 36.

‡1874. *Typhis alatus* Sowerby, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 438.

Six strongly worn specimens from Matura are at hand. Most of them are fragmentary and immature. There are four tubes per whorl, situated a little closer to the preceding varix. Last varix narrower above aperture. No spiral sculpture present (due to washing?).

T. quadratus Hinds (Zool. Soc. London, Proc., pt. 11, p. 18, 1843) from the Recent fauna of the tropical Eastern Pacific has been assigned to the subgenus *Typhina* by Keen, 1944 (p. 55) but to *Typhinellus* by Keen, 1958 (p. 367). The collections of the U. S. National Museum contain only five worn specimens of *T. quadratus* from Venado Beach, Panama Canal Zone. They are somewhat larger than the largest Matura shell, and the tubes of the latest whorls are closer to the preceding varix than it is the case in the Matura specimens. On earlier whorls, however, the tubes are midway between the varices like on earlier whorls of Matura specimens.

Occurrence. — JS 67, PJ 302, USGS 19860.

Typhis (subgenus ?) species

A single specimen from the Melajo Clay measuring 11.6 mm in height is too incomplete and worn to point out specific affinities.

It has four tubes per whorl which are situated somewhat closer to the preceding varix. It probably belongs to *Typhinellus* and may represent the same species as the shells from Matura.

Occurrence. — USGS 21178.

Genus **CALOTROPHON** Hertlein and Strong

Hertlein and Strong, 1951, New York Zool. Soc., Zoologica, vol. 36, pt. 2, p. 87.

Type species (by original designation), *Calotrophon bristolae* Hertlein and Strong.

Calotrophon (?) **hutchisoni**, n. sp.

Pl. 50, figs. 7-9

Shell small, solid. Protoconch consists of $11\frac{1}{2}$ whorls, its last part with a basal angulation. Postnuclear whorls a little more than five. Sculpture starting abruptly, consists of nine axials on early whorls, but of seven on late whorls. Axials usually with a short vaulted spine on the shoulder of the whorls. There are two to four weak spirals above the shoulder, and two stronger ones below. Axials not persistent from suture to suture. Body whorl with numerous spirals below the shoulder; its axials usually reaching down to the prominent siphonal fasciole. Outer lip lirate within, its edge crenulated. Callus of inner lip prominent, with four elongate denticles near the base. Anterior canal short, slightly recurved.

Holotype. — USNM 645494.

Dimensions of holotype. — Height 16.6 mm, diameter 9.4 mm.

Type locality. — Melajo River area: USGS 21178.

This species occurs in the Melajo Clay and is represented by numerous specimens. The hollow, short spines on the shoulder are not always present. Single individuals may have spines in certain stages, but none in others. The strength of the axials below the shoulder of the body whorl is variable also.

The Recent *G. bristolae* Hertlein and Strong [1940-1951 (1951), p. 87, pl. 2, fig. 2] from the Gulf of California, the type species of the genus, is larger, has a higher spire, and it lacks the denticles near the base of its inner lip. Keen (1958, p. 364) treated *Calotrophon* as a subgenus of *Trophon*.

A Western Atlantic species similar to *G. bristolae* is *Urosalpinx floridana* Conrad (1869, p. 106, pl. 12, fig. 4), for which Olsson and Harbison (1953, p. 254) erected the subgenus *Pseudosalpinx*.

U. floridana is said to be the same as *Murex ostrearum* Conrad (1846, p. 25) (see also Robertson, 1957, p. 8).

Occurrence. — Hutch 47, K 9797, KR 11862, PJ 285, USGS 18399, USGS 21178.

Genus **RISOMUREX** Olsson and McGinty

Olsson and McGinty, 1958, Bull. Amer. Paleont., vol. 39, No. 177, p. 40.

Type species (by original designation), *Engina schrammi* Crosse.

Risomurex galbensis, n. sp.

Pl. 50, figs. 10-13

Small, stout. Protoconch consists of a little less than $1\frac{1}{2}$ smooth whorls. It is strongly keeled and flattened above forming a depression at the apex. Postnuclear whorls about five. Early sculpture consists of axials (about 10 on first sculptured whorl) and two spirals form beads at the intersections. On subsequent whorls the axials become much stronger, and the upper spiral forms a shoulder with acute nodes, where the axials cross. On the second or third sculptured whorl another spiral appears close to the lower suture which is noded as well. Spaces between spirals ornamented by several fine spirals. Body whorl with six to seven noded spirals and eight axials, the last ones being varix-like. Unworn specimens show undulating, somewhat lamellar growth lines. Outer lip thick, with five denticles on inner surface. Inner lip with two inconspicuous lirae on lower part. Anterior canal short. Siphonal fasciole inconspicuous.

Holotype. — USNM 645367.

Dimensions of holotype. — Height 13.8 mm, diameter 7.7 mm.

Type locality. — Point Courbaril: USGS 10991.

This species occurs in the Courbaril beds and is represented by about 50 specimens. Many of them are immature or strongly worn.

The type species of *Risomurex*, the Recent *R. schrammi* (Crosse) (1863, p. 82, pl. 1, fig. 7) from Guadeloupe, has about the same apical angle as *R. galbensis* but has heavier nodes and more spirals on the body whorl. Its protoconch has been figured by Olsson and McGinty (1958, pl. 2, fig. 2). The axials on the first sculptured whorl are much less prominent than in *R. galbensis*. *R. roseus* (Reeve) (Conch. Icon., vol. 3, *Ricinula*, pl. 6, fig. 46, 1856) has similar early stages and lamellar growth lines like *R. galbensis* but

differs in having heavier and more crowded nodes. *R. muricoides* (C. B. Adams) (1845, p. 3; Clench and Turner, 1950, p. 313, pl. 39, fig. 9), originally described from Jamaica, is a more slender species with more spirals on the body whorl. *Tritonalia (Ocinebrina) caribbaea* Bartsch and Rehder (1939, p. 7, pl. 1, fig. 1) is considered a synonym of *R. muricoides* by Olsson and McGinty (1958, p. 41).

Muricidea striata Gabb (1873b, p. 203; Pilsbry, 1922, p. 354, pl. 28, fig. 7) from the Miocene of the Dominican Republic somewhat resembles *R. galbensis*. The outer lip of the type is not thickened (immature ?), and the protoconch is unknown. No topotypes are available.

Occurrence.—K 1429, K 8399, RR 120, PJ 212, USGS 10991, USGS 21778.

Family **THAIDIDAE**

Genus **THAIS** Röding

Röding, 1798, in *Museum Boltenianum*, p. 54.

Type species (by subsequent designation, Stewart, 1927, *Acad. Nat. Sci. Philadelphia, Proc.*, vol. 78, p. 386), *Thais lena* Röding (= *Murex fucus* Gmelin = *Murex neritoideus* Linné = *Nerita nodosa* Linné).

Subgenus **STRAMONITA** Schumacher

Schumacher, 1817, *Essai d'un nouveau système des habitations des vers testacés*, p. 226.

Type species (by subsequent designation, Gray, 1847, *Zool. Soc. London, Proc.*, pt. 15, p. 138), *Buccinum haemostoma* Linné.

Thais (Stramonita) cf. haemostoma (Linné)

?1912. *Purpura* sp. indet., Maury, *Acad. Nat. Sci. Philadelphia, Jour.*, 2d ser., vol. 15, p. 82, pl. 12, fig. 4.

A few shells from the Courbaril beds and one specimen from Matura are identified as *T. cf. haemostoma*. They are all immature. As pointed out by Clench (1947, p. 73, pl. 36, figs. 1-6) *T. haemostoma* is a strongly variable species. Even the immature Courbaril specimens show considerable variation as to sculpture and shape.

The fragment described and illustrated by Maury as *Purpura* sp. indet. has been collected from a locality just south of the Pitch Lake, Trinidad, which is thought to be about the stratigraphic equivalent of the Courbaril beds.

T. haemostoma has been reported from the Pliocene of Venezuela by Weisbord (1962, p. 300, pl. 27, figs. 3, 4).

Occurrence. — Point Courbaril: RR 120, USGS 10991, USGS 20432a, USGS 20434, USGS 21778. Matura Bay: USGS 19860.

Thais (Stramonita) species A

Pl. 51, figs. 5, 6

Of small to medium size. Spire high. Protoconch with about $2\frac{1}{2}$ smooth, inflated whorls. Postnuclear whorls 4 to $4\frac{1}{2}$. Early sculpture consists of numerous axials and about six spirals. The third spiral from the lower suture forms a shoulder. On subsequent whorls the shoulder becomes nodose, and the spiral next to the lower suture more prominent. Additional spirals are intercalated, and the axial sculpture disappears except for the slightly lamellar growth lines. Body whorl with seven projecting nodes on shoulder, and a similar, but less prominent, noded spiral below. Surface of body whorl covered by closely spaced, fine spirals of variable strength. Inner surface of outer lip with conspicuous lirations. Columella smooth. Anterior canal short. Siphonal fasciole inconspicuous.

This form is represented by three specimens from the base of the Melajo Clay. Only the figured one is complete.

This species is allied to the Recent Caribbean *T. rustica* (Lamarck) (see Clench, 1947, p. 80, pl. 39, figs. 4-6, 8, 10). Although *T. rustica* is variable as to height of spire and strength of sculpture, the Melajo specimens differ in having fewer and much more prominent nodes on the body whorl. The spire of *T. rustica* usually is shorter.

Occurrence. — USGS 18411, USGS 18634.

Genus CYMIA Mörch

Mörch, 1861, Malakozoologische Blätter, vol. 7, p. 98 (substitute name for *Cuma* Swainson).

Type species (by monotypy), *Cuma sulcata* Swainson (= *Buccinum tectum* Wood).

Cymia brightoniana Maury

Pl. 51, figs. 1-4

1912. *Cymia woodii* Gabb, Maury, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 15, p. 82, pl. 11, figs. 9, 10.

1925. *Cymia brightoniana* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 215.

Moderately large to large, solid. Spire high. Protoconch consists of a little more than one whorl. Postnuclear whorls about six.

Early sculpture of numerous axials and three spirals, the lowest one forming a keel. On subsequent whorls the axials disappear, and additional spirals are intercalated. On the lowest spiral spirally elongated, projecting nodes are developed. Growth lines slightly lamellar, well visible on spirals. Body whorl covered by numerous closely set spirals of variable strength. Anal notch inconspicuous, anal ridge prominent. Columellar fold strong. Inner surface of outer lip with long, spiral ridges. Siphonal canal short. Siphonal fasciole prominent, lamellar.

Holotype. — Cornell University, Paleont. Museum, Ithaca, N.Y., No. 33609.

Type locality. — Along shore, 700 feet east of Brighton pier, near Pitch Lake, Trinidad.

This species is abundant in the Courbaril beds but well-preserved specimens are rare. The holotype has a second spiral with nodes below the angulation of the body whorl. This feature is not observed on specimens of later collections.

An immature, badly preserved specimen from the Melajo Clay (USGS locality 21178) is identified as *Cymia* species.

C. brightoniana is most closely related to the Recent Eastern Pacific *C. tecta* (Wood) (Supplement to the Index Testaceologicus, p. 12, pl. 4, fig. 13, 1828) which ranges from El Salvador to Ecuador. The apical angle of both species is variable to some degree. Their anal notch is inconspicuous. *C. tecta* differs in having fewer spirals with deeply incised interspaces.

The Caribbean Miocene species of *Cymia* have been discussed by Woodring (1959, pp. 223, 224). *C. brightoniana* and *C. tecta* have a much shallower anal notch than most of these species. As stated by Woodring *C. brightoniana* is the youngest species of the genus in the Caribbean region.

Occurrence. — K 12255, PJ 212, USGS 10991, USGS 20432, USGS 20432a, USGS 21778.

Distribution. — Known from type area only.

Family **COLUMBELLIDAE**

Genus **PARAMETARIA** Dall

Dall, 1916, *Nautilus*, vol. 30, No. 3, p. 25. Substitute name for *Meta* Reeve (April 1859, *Conch. Icon.*, vol. 11, *Columbella*, pl. 32, under remarks for *C. picata* Swainson) which is a genus without species and preoccupied by *Meta* Koch, 1835.

Type species of *Meta* Reeve (by subsequent designation, Reeve, May 1859, Conch. Icon., vol. 11, *Meta*, pl. 1, under discussion of *Meta ovuloides*), *Conus dupontiae* Kiener.

Compare also Grant and Gale (1931, p. 680). Reeve's emendation of *Conus "dupontii"* Kiener to *dupontiae* is correct, because the species was named for Mrs. Dupont.

Parametaria prototypus (Guppy)

Pl. 51, figs. 7-9; Pl. 52, figs. 1-2

1867. *Conus protoypus* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 171; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 50.

1874. *Conus prototypus* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 409, 440, pl. 17, fig. 9, pl. 18, fig. 1.

1942. *Pyrene (Eupyrene) ? schideri* Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 148, pl. 5, figs. 5a, 5b.

Of medium size, stout. Spire high. Protoconch consists of about two volutions which are not well distinguishable from subsequent whorls. Postnuclear whorls about six. The first postnuclear whorls are smooth and small. Subsequently the apical angle enlarges considerably, and the whorls become shouldered. Above the shoulder there may be a narrow, concave, spiral band not reaching the upper suture. Growth lines opisthocyrte above shoulder, almost orthocline below. Body whorl smooth and inflated above, constricted and sculptured by some spirals below. Last part of suture slightly ascending toward apex. Aperture long. Inner lip with thin callus which reaches down to the base of the columella. Lower part of inner lip with a few oblique, short denticles. Outer lip thin, smooth within. Anterior canal short, bordered by an inconspicuous ridge.

Holotype. — USNM 115593.

Dimensions of holotype. — Height 12.2 mm, greatest diameter 7.8 mm.

Type locality. — Guppy's Savanetta (Caroni Series), which is a locality near Savanetta River roughly corresponding to the locality Brechin Castle Estate referred to by Rutsch (1942, p. 105, fig. 1).

Guppy based his species on a single, immature shell. Later collections contain several adult specimens from the type area. The holotype of Rutsch's *Pyrene schideri* was collected at Springvale Quarry. *P. prototypus* is represented from the base of the Melajo Clay by one immature and one adult shell. The outer lip of the latter is broken.

The generic assignment of this species is based on the variability of the type species of *Parametaria*, the Recent Eastern Pacific *P. dupontiae* (Kiener) (*Spécies général et Iconographie des coquilles vivantes*, *Comus*, pl. 61, fig. 2, 1846; p. 273, 1849-50. For dates see Sherborn and Woodward, 1901, *Malac. Soc. London, Proc.*, vol. 4, pp. 216-219). The collections of the U.S. National Museum contain a fairly good representation of *P. dupontiae* which shows that the height of the spire is strongly variable. The shoulder, which mostly is visible on the body whorl only, may be angulated or rounded. Denticles on the inner surface of the outer lip may be strongly developed, weak, or absent even in adult specimens.

P. prototypus is more loosely coiled than *P. dupontiae*, and its shoulder is never so strongly angulated. *Meta perplexabilis* Maury (1917, p. 94, pl. 15, figs. 4, 5), from the middle Miocene Cercado Formation of the Dominican Republic, is smaller, more slender, and has denticles on the inner surface of the outer lip. It probably is not a *Parametaria*.

Occurrence.—USGS 18634.

Distribution.—Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

***Parametaria rutschi*, n. sp.**

Pl. 52, figs. 3-6

Of medium size, coniform. Spire low. Protoconch consists of a little more than one whorl but is not well separable from later whorls. Postnuclear whorls numbering up to $7\frac{1}{2}$. Spire whorls tightly coiled, smooth except for opisthocyrt growth lines. Body whorl with angulated shoulder, slightly inflated above, constricted below. Lower part of body whorl sculptured by numerous spirals. Aperture long and narrow. Suture near aperture ascending over the shoulder of penultimate whorl. Outer lip strongly thickened, with numerous denticles within. Inner lip with a thin callus. There is a spiral ridge on the lower part of the columella which is not visible in complete specimens.

Holotype.—Natural History Museum Basel, No. H 15171.

Dimensions of holotype.—Height 22.2 mm, diameter 15.0 mm.

Type locality.—Matura Bay: RR 230.

This species is based on four specimens from Matura. Already Rutsch (private report, 1942) considered them to represent a new

species. *P. rutschi* differs from *P. prototypus* in having a tightly coiled, lower spire, and in having more spirals on the body whorl. The outer lip ascends over the shoulder of the penultimate whorl which is not the case in *P. prototypus*.

P. rutschi is most closely allied to the Recent Eastern Pacific *P. dupontiae* (Kiener) (for references see under *P. prototypus*). They have about the same dimensions. But *P. rutschi* has a thicker outer lip with stronger denticles within. There are less spirals on the body whorl of *P. dupontiae*, and they are more restricted to the base. *P. islahispaniolae* (Maury) (1917, p. 93, pl. 15, fig. 3) from the middle Miocene Cercado Formation of the Dominican Republic is considerably smaller and more slender. Its first three post-nuclear whorls have axially elongated nodes near the lower suture.

P. rutschi is the youngest species of the genus in the Caribbean. *Parametaria* survived to the Recent fauna in the Eastern Pacific, where it is represented by two species.

Occurrence.—RR 230.

Genus **ANACHIS** H. and A. Adams

H. and A. Adams, 1853, *The Genera of Recent Mollusca*, vol. 1, p. 184.

Type species (by subsequent designation, Tate, 1870, *in*: Appendix to S. P. Woodward's *A manual of the Mollusca*, 2d edition, p. 13), *Columbella scalarina* G. B. Sowerby I.

Subgenus **ANACHIS** s. str.

Anachis (Anachis) asphaltoda (Maury)

Pl. 52, figs. 7-10

1912. *Columbella asphaltoda* Maury, *Acad. Nat. Sci. Philadelphia, Jour.*, ser. 2, vol. 15, p. 81, pl. 12, fig. 2.

1925. *Columbella asphaltoda* Maury, Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 211.

Of medium size, stout. Whorls flat-sided. Protoconch consists of about three whorls. Postnuclear whorls about seven. Early sculpture with numerous axials and one spiral on the upper half of the whorl which forms beads at the intersections. Subsequently this spiral gradually disappears and a few (six to eight) fine spiral grooves appear which cross the axials. Axials near outer lip not reaching the base. Outer lip moderately thick, with a few denticles within, the uppermost one larger than the others. Inner lip with a moderately thick callus and a few small denticles near base. Anterior canal short.

Type. — The syntype figured in this paper (Cornell University, Paleont. Museum, Ithaca, N. Y., No. 33511) does not correspond to Maury's figured specimen.

Type locality. — Along shore, 700 feet east of Brighton pier, near Pitch Lake, Trinidad.

The syntype of *A. asphaltoda* figured in this paper is a worn, incomplete specimen. In later collections this species is represented by more than 50 specimens. They do not grow larger than 18 mm. A single, worn, incomplete shell from Matura is somewhat larger.

A. asphaltoda is most closely related to the Recent Eastern Pacific *A. varia* (G. B. Sowerby I) (1832, p. 116). Both species have the same stoutness and agree even in details of their sculpture. However, *A. varia* is larger, has more inflated whorls, and its axials tend to be sinuous on late whorls. *A. varia* has been cited by Gabb (1881b, p. 355) from the Pliocene of Costa Rica. The type species of *Anachis*, the Recent Eastern Pacific *A. scalarina* (G. B. Sowerby I) (1832, p. 116) is easily distinguished from *A. asphaltoda* by its shouldered whorls.

A. dalli Olsson (1964, p. 150, pl. 28, fig. 4), from the late Miocene to early Pliocene Esmeraldas Formation of Ecuador, is a more slender species with less pronounced axials and a higher aperture.

Occurrence. — Point Courbaril: K 1429, K 12255, PJ 212, USGS 10991, USGS 20432, USGS 20433, USGS 20434, USGS 21778. Matura Bay: USGS 19860.

Distribution. — Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed (rare).

Anachis (Anachis) species

A single, incomplete specimen (height 15.1 mm) from Matura is characterized by its strong axials which number 14 on the body whorl. Protoconch consists of about $1\frac{1}{2}$ whorls. Postnuclear whorls five. Spire whorls strongly worn but apparently with a spiral near the upper suture producing small nodes at the intersections. Otherwise the spiral sculpture seems to be restricted to a few spirals near the base. Outer lip partly broken, but on its lower part a few denticles are visible. Anterior canal short but deeply notched. The axials are straight on early whorls but slightly sinuous on the body whorl.

This form is more slender and has stronger axials than *A. asphaltoda*. It has some resemblance to the Recent *A. fusidens* (Dall) (1908, p. 309, pl. 11, fig. 13) which had been dredged near the Galapagos Islands from 300 fms. They have the same dimensions and stoutness.

Occurrence. — RR 230.

Subgenus **COSTOANACHIS** Sacco

Sacco, 1890, I molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 6, p. 57.

Type species (by subsequent designation, Pace, 1902, Malac. Soc. London, Proc., vol. 5, p. 43), *Columbella (Anachis) turrita* Sacco.

Anachis (Costoanachis) obesa (C. B. Adams) Pl. 52, fig. 11

1845. *Buccinum obesum* C. B. Adams, Boston Soc. Nat. Hist., Proc., vol. 2, p. 2.
 1912. *Columbella labreana* Maury, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 15, p. 80, pl. 12, fig. 1.
 1925. *Columbella (Anachis) labreana* Maury, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 211.
 1948. *Anachis (Costoanachis) obesa* (C. B. Adams), Gardner, U. S. Geol. Sur., Prof. Paper 199-B, p. 229, pl. 30, fig. 26.
 1950. *Buccinum obesum* C. B. Adams, Clench and Turner, Occas. Papers on Mollusks, vol. 1, No. 15, p. 319, pl. 32, fig. 11.
 1953. *Anachis (Costoanachis) obesa* (C. B. Adams), Olsson and Harbison, Acad. Nat. Sci. Philadelphia, Mon. No. 8, p. 232, pl. 38, fig. 11.
 1962. *Anachis (Costoanachis) obesa* (C. B. Adams), Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 310, pl. 27, figs. 18-23. For further citations see this publication.

Lectotype. — Museum of Comparative Zoology, Cambridge, Mass., No. 156016.

Type locality. — Jamaica (Recent).

This common Recent Caribbean species is abundant in the Melajo Clay and at Matura but less so in the Courbaril beds. The type specimen of Maury's *Columbella labreana* is lost. The Courbaril specimens of the present collection are virtual topotypes of *C. labreana*.

The Recent *A. obesa* ranges from the Chesapeake Bay through the West Indies as far south as Argentina. It is a highly variable species as to apical angle (stoutness) and strength of sculpture. The variability does not only depend on geographical occurrence; it can be observed in single lots to some degree. The same is true for the lots from Matura and the Melajo Clay.

Occurrence. — Melajo River area: EL 1810, KR 11862, PJ 285, USGS 18399, USGS 21178. Point Courbaril: PJ 212, USGS 10991. Matura Bay: K 10924, JS 67, RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution. — Miocene to Recent (see Weisbord, 1962, p. 313).

Anachis (Costoanachis) fraudans, n. sp.

Pl. 53, figs. 1-5

Of medium size, slender. Protoconch consists of almost four smooth whorls; but not well separated from postnuclear whorls. Postnuclear whorls six. Axial sculpture moderately strong to absent. Axials slightly opisthocyr. There is an obsolete subsutural spiral producing small nodes on moderately sized axials. A spiral groove runs along the lower suture. Outer lip moderately thickened, denticulated within. Callus of inner lip well developed, with fine denticles. Pillar sculptured by numerous spirals, the upper ones more closely spaced.

Holotype. — USNM 645502.

Dimensions of holotype. — Height 12.1 mm, diameter 4.2 mm.

Type locality. — Melajo River area: USGS 21178.

This species is based on four specimens from the Melajo Clay. They are constant as to apical angle, but their axial sculpture is strongly variable. The holotype has weak axials. They start on the third postnuclear whorl and persist for a little less than one whorl; for about half a whorl they are absent, but appear again. One of the paratypes has fairly strong axials which start on the third postnuclear whorl and persist to the body whorl. This shell has a well-developed subsutural spiral, and the spiral groove near the lower suture cuts through the axials. On the other hand another paratype with five postnuclear whorls lacks the axial sculpture almost entirely.

A similarly variable axial sculpture has been described for *A. mira* (Dall) (*in* Guppy and Dall, 1896, p. 312, pl. 29, fig. 7) by Woodring (1964, p. 248, pl. 39, figs. 13-18). *A. mira* occurs in the middle and late Miocene Gatun Formation of the Panama Canal Zone, and in the middle Miocene of Costa Rica. *A. fraudans* is never so stout as some specimens of *A. mira*, its spiral groove near the lower suture is more conspicuous, and it is larger on an average.

Occurrence. — KR 11862, PJ 285, USGS 21178.

Genus **ZANASSARINA** Pilsbry and Lowe

Pilsbry and Lowe, 1932, Acad. Nat. Sci. Philadelphia, Proc., vol. 84, p. 75.

Type species (by original designation), *Nassarina* (*Zanassarina*) *poecila* Pilsbry and Lowe.

Zanassarina species

Pl. 53, figs. 6, 7

Small, slender. Protoconch with three conical, smooth whorls. Postnuclear whorls $4\frac{1}{2}$. Sculpture consists of axials and three somewhat narrower spirals producing a reticulate sculpture. Axials more widely spaced than spirals. Interspaces deep, pitlike. Intersections with nodes. Body whorl with eight spirals and a smaller, sub-sutural spiral which appears on the penultimate whorl already. Outer lip thickened, with three denticles within. Anal sinus shallow. Inner lip with a prominent callus, smooth. Anterior canal short.

This form is represented by two specimens from Matura. They have some resemblance with *Z. habra* Woodring (1964, p. 250, pl. 39, figs. 9, 10) from the middle Miocene Gatun Formation of the Panama Canal Zone. *Z. habra* is somewhat larger, its whorls are higher, and its axials stronger. The form from the Bowden Formation of Jamaica described by Woodring (1928, p. 280, pl. 16, fig. 20) as *Nassarina* species has even stronger axials than *Z. habra*.

Occurrence.—JS 67, USGS 18204.

Genus **AESOPUS** Gould

Gould, 1860, Boston Soc. Nat. Hist., Proc., vol. 7, p. 383.

Type species (by monotypy), *Aesopus japonicus* Gould.

Aesopus peculiaris (Guppy)

Pl. 53, figs. 8-10

- 1867. *Columbella peculiaris* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 158, 171; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 37, 50.
- 1874. *Columbella peculiaris* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 411, 439, pl. 18, fig. 20.
- 1896. *Aesopus peculiaris* (Guppy), Dall, in Guppy and Dall, U. S. Nat. Mus., Proc., vol. 19, No. 1110, p. 328.
- 1916. *Aesopus myrmecoon* Dall, Nautilus, vol. 30, No. 3, p. 27.
- 1919. *Aesopus sanctus* Dall, Biol. Soc. Washington, Proc., vol. 32, p. 250.
- 1927. *Aesopus sanctus* Dall, Oldroyd, Stanford Univ. Publ., Geol. Sci., vol. 2, pt. 1, p. 279.
- 1938. *Aesopus sanctus* Dall, Baker, Hanna, and Strong, Calif. Acad. Sci., Proc., 4th ser., vol. 23, No. 16, p. 252, pl. 24, fig. 7.

Small, solid. Protoconch with a little less than two smooth volutions; initial whorl large. Postnuclear whorls about $4\frac{1}{2}$, slightly

inflated. Sculpture consists of numerous, fine, closely spaced spirals. Near the upper suture the whorls are slightly concave, and one spiral may be somewhat more prominent or one interspace wider than the others. Interspaces with microscopical, axial striation. Suture distinct, sloping more steeply on penultimate and body whorls. Aperture low. Outer lip not thickened, with a few weak denticles at some distance from the margin. Inner lip with a thin callus. Siphonal fasciole slightly bulging. Anterior canal short, somewhat twisted to the left.

Lectotype. (herewith selected). — USNM 115520.

Dimensions of lectotype. — Height 5.0 mm, diameter 1.8 mm.

Type locality. — Matura, Trinidad.

The type lot of *A. peculiaris* consists of four specimens which had been glued to a card. In later collections the species is represented by 15 specimens.

The type specimen of the Recent *A. myrmecoon* (USNM 105498) has been collected at Point Abrejos, Lower California. It seems to be an immature specimen with $3\frac{1}{2}$ postnuclear whorls. The type specimen of *A. sanctus* (USNM 308958) from Todos Santos Bay, near San Diego, California, as well as several topotypes, are at hand. They are slightly worn but show the axial striation between the spirals. The spirals tend to be a little narrower, but otherwise *A. sanctus* is indistinguishable from *A. peculiaris*.

Tryon (Manual of Conchology, vol. 5, p. 179, pl. 58, fig. 48, 1883) described *Columbella* (*Seminella*) *stearnsii* from Tampa Bay, West Florida (see also Dall, 1889a, p. 194, pl. 29, fig. 5). Dall [1890-1903 (1890), p. 138] cited *A. stearnsii* (Tryon) from the Pliocene of Florida, and Gardner [1943-1948 (1948), p. 232, pl. 30, fig. 19] from the Pliocene of North Carolina, South Carolina, and Florida. *A. stearnsii* is somewhat variable as to inflation of the sculptured whorls. It differs from *A. peculiaris* only by its slightly larger and more inflated nuclear whorls. But even this difference does not seem to be constant. *A. stearnsii* should possibly be synonymized with *A. peculiaris* as well.

The Recent *A. chrysalloideus* (Carpenter) (see Palmer, 1958, p. 213, pl. 23, figs. 18-20) from Southern California is about twice as large as *A. peculiaris*.

Occurrence. — RR 230, PJ 302, USGS 19860.

Distribution. — Matura shell bed, Trinidad. Recent, Southern California to Gulf of California.

Aesopus aff. **metcalfei** (Reeve)

Pl. 53, fig. 11

Of medium size, slender. Protoconch with about $11\frac{1}{2}$ smooth volutions; initial whorl large. Postnuclear whorls almost six. Sculpture consists of obsolete axials on early whorls and minute spirals. Aperture low. Outer lip thin, with a few denticles at a distance from the margin. Inner lip with a conspicuous callus. Anterior canal short, deeply notched.

This form is represented by three specimens from Matura. They are worn and their axials hardly recognizable. They differ from the Recent West Atlantic *A. metcalfei* (Reeve) (Conch. Icon., vol. 12, *Terebra*, pl. 26, species 139, 1860) in having faint spiral sculpture. Unworn specimens of *A. metcalfei* have stronger axial sculpture and are somewhat larger. Both forms have denticles on the outer lip.

Occurrence. — JS 67, RR 230.

Genus **STROMBINA** Mörch

Mörch, 1852, *Catalogus conchyliorum* . . . Comes de Yoldi, pt. 1, p. 85.

Type species (by subsequent designation, Cossmann, 1901, *Essais de paléoconchologie comparée*, pt. 4, p. 241), *Columbella lanceolata* G. B. Sowerby I (for the substitute name *Strombocolumbus*).

Strombina (subgenus ?) **melaioensis**, n. sp.

Pl. 53, figs. 12, 13

Of medium size, slender. Spire high. Protoconch with three smooth volutions. Postnuclear whorls about eight, smooth except for minute spiral striae near the upper suture on the first three to four postnuclear whorls. Spire whorls flat to slightly convex, not shouldered. Body whorl stout, flattened in front, with a dorsal hump. Aperture low. Outer lip thickened, with about six denticles on inner surface. Posterior canal moderately prominent, bordered to the left by a callous ridge. Callus of inner lip prominent and detached from pillar on lower part, carrying a few denticles. Anterior canal short, deeply notched. Pillar sculptured by a few spirals.

Holotype. — USNM 645493.

Dimensions of holotype. — Height 16.9 mm, diameter 7.1 mm.

Type locality. — Melajo River area: USGS 18634.

This species is based on three specimens from the Melajo Clay. Its high, slender spire; the low, stout body whorl, and its almost complete lack of sculpture are distinctive.

The lack of sculpture recalls *S. quirosana* H. K. Hodson (*in* Hodson and Hodson, 1931a, p. 27, pl. 10, figs. 12, 13) from the early Miocene of Venezuela. But that species is smaller, and lacks the dorsal hump. Somewhat larger specimens of *S. quirosana* from the middle Miocene of the Paraguaná Peninsula, Venezuela, have been referred to *Mitrella* (Jung, 1965, p. 529, pl. 71, figs. 3, 4).

Most closely related to *S. melajoensis* is the Recent Eastern Pacific *S. dorsata* (G. B. Sowerby I) (1832, p. 120) which ranges from the Gulf of California to Ecuador according to Keen (1958, p. 394). *S. dorsata* is larger, its later whorls slightly shouldered, and its body whorl proportionately higher. Somewhat immature *S. dorsata* is even closer to *S. melajoensis*.

The Recent *S. clavulus* (G. B. Sowerby I) (1833-1834, p. 134, 1834) from the Eastern Pacific (Keen, 1958, p. 394) has similar proportions, but has a deep notch in the upper part of the outer lip, and lacks a prominent dorsal hump.

Occurrence. — Melajo River area: USGS 18634, USGS 21178.

Subgenus **SINCOLA** Olsson and Harbison

Olsson and Harbison, 1953, Acad. Nat. Sci. Philadelphia, Mon. 8, p. 230.

Type species (by original designation), *Strombina sincola* Olsson.

Strombina (Sincola) crassilabrum (Guppy)

Pl. 53, figs. 14-20

1874. *Planaxis crassilabrum* Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 411, 439, pl. 18, fig. 13.

1928. *Strombina crassilabrum* (Guppy), Woodring, Carnegie Inst. Washington Pub. 385, p. 341.

Small, stout. Protoconch with a little more than three smooth volutions. Postnuclear whorls six. Early sculpture consists of 11 to 12 narrow, straight axials and an inconspicuous spiral along the upper suture which causes small nodes at the intersections. The spiral disappears soon, but the axials may persist to the prepenultimate whorl. Body whorl large, smooth, slightly compressed, with a small dorsal hump. Outer lip strongly thickened; with a few denticles on its lower part, and two stronger denticles on its upper

part. The interspace of the two stronger denticles is slightly notched. Posterior canal well developed, its left margin formed by a callous ridge. Inner lip with a thin callus and a few small denticles on its lower part. Pillar sculptured by spirals. Anterior canal short, deeply notched.

Lectotype (herewith selected). — USNM 115492.

Dimensions of lectotype. — Height 7.7 mm, greatest diameter 5.1 mm.

Type locality. — Matura, Trinidad.

Guppy based his species on three poorly preserved fragments. Although Guppy's original figure shows a complete spire, none of these fragments has the spire preserved. In later collections *S. crassilabrum* is represented from the type locality by a few fragments and one almost complete specimen (Pl. 53, figs. 19, 20).

S. crassilabrum is well represented in the Courbaril beds, but the best specimens have been found in the Melajo Clay. The axial sculpture is restricted to the first two postnuclear whorls in specimens from Matura and Point Courbaril but may be developed on the first four postnuclear whorls in Melajo shells.

S. walli Mansfield (1925, p. 47, pl. 8, figs. 5, 7) from the middle Miocene of Trinidad is a considerably smaller species with heavier denticles on the outer lip. Its body whorl is somewhat shouldered by the dorsal hump, and its axial sculpture is inconspicuous. The late Miocene *S. cunninghamcraigi* (Rutsch) (1942, p. 148, pl. 3, figs. 12a, 12b) from Springvale Quarry has more closely spaced axials which persist to the penultimate whorl. It lacks a dorsal hump.

Much more closely related than the above mentioned species is *S. gibberula galvestonensis* (Harris) (1895, p. 21, pl. 4, fig. 6) which had been obtained from a well near Galveston, Texas (upper Miocene ?). According to Harris' figure it has a less well-developed posterior canal.

There are no living species of the subgenus *Sincola* in the Western Atlantic. The Recent Eastern Pacific *S. gibberula* (G. B. Sowerby I) (1832, p. 115) lacks the axial sculpture on early whorls. *S. gibberula* has been recorded from the Pliocene of Ecuador by Pilsbry and Olsson (1911, p. 35), and the Pleistocene of Lower California by Grant and Gale (1931, p. 699).

Occurrence. — Melajo River area: KR 11862, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, USGS 10991, USGS 20434. Matura Bay: JS 67, RR 230, USGS 18204.

Distribution. — Melajo Clay Member of Springvale Fm., Courbaril beds of Upper Morne l'Enfer Fm., Matura shell bed.

Genus **STROMBINOPHOS** Pilsbry and Olsson

Pilsbry and Olsson, 1941, Acad. Nat. Sci. Philadelphia, Proc., vol. 93, p. 35.

Type species (by original designation), *Strombinophos loripanus* Pilsbry and Olsson.

Strombinophos perdoctus, n. sp.

Pl. 53, figs. 21, 22

Of medium size, slender. Spire high. Protoconch consists of four smooth whorls. Postnuclear whorls up to six. First sculpture consists of about four opisthocyrt axials. The following axials gradually become orthocline and are crossed by about five spirals. On subsequent whorls there are three to four primary spirals with one secondary spiral in each interspace. Between the uppermost primary spiral and the suture there are two spirals of secondary size. Axials near the outer lip crowded. Outer lip moderately to strongly thickened, lirate within. Near the base of the outer lip there is an inconspicuous emargination. Columellar callus denticulate. Anterior canal short, straight. Siphonal fasciole inconspicuous.

Holotype. — USNM 645503.

Dimensions of holotype. — Height 14.8 mm, greatest diameter 6.0 mm.

Type locality. — Melajo River area: USGS 21178.

S. perdoctus is represented in the Melajo Clay by eight specimens. It is most closely related to *S. maxwelli* Olsson and Harbison (1953, p. 238, pl. 33, fig. 11) from the Pliocene of St. Petersburg, Florida. *S. perdoctus* is distinguished by having a four-whorled protoconch, a larger apical angle, less axials, and a more inflated body whorl. The middle Miocene *S. estrellensis* (Olsson) (1922, p. 120, pl. 9, figs. 17, 18) from Costa Rica has also a four-whorled protoconch, but is somewhat stouter, and may reach a larger size.

S. mimicus Woodring (1964, p. 251, pl. 39, fig. 20, pl. 40, figs. 26, 27), from the middle Miocene Gatun Formation of Panama, has more numerous but less elevated axials. *S. telembus* Olsson

(1964, p. 157, pl. 36, fig. 7) from the middle Miocene of Ecuador may be the same as *S. mimicus*.

Occurrence. — K 9903, PJ 285, USGS 18399, USGS 21178.

Strombinophos species

Two fragments show that this genus occurs at Matura as well. The smaller fragment consists of part of the protoconch and the three first sculptured whorls, the larger one of the body whorl. The body whorl is larger, and has finer axials than that of *S. perdoctus*, n.sp.

Occurrence. — USGS 19860.

Family **BUCCINIDAE**

Buccinid indet.

Pl. 54, figs. 1-4

Of medium to large size, solid. Protoconch missing. Sculptured whorls about six. Early sculpture consists of rounded axials (10 per whorl) extending from suture to suture. They are crossed by spirals of two orders of magnitude. Near the middle of the whorl two spirals are more prominent than the others; the upper one is situated on a gradually developing shoulder which is most prominent on the body whorl. As the shoulder develops the axials do not extend from suture to suture any more. Body whorl with nine axially elongated nodes on the shoulder and numerous spirals of three orders of magnitude. Aperture low. Outer lip not thickened, lirate within. Inner lip with a ridge near the posterior end of the aperture. Siphonal fasciole moderately swollen, sculptured by spirals and slightly lamellar growth lines. Anterior canal short, relatively broad.

This form occurs in the Courbaril beds and is represented by one almost complete, but worn shell and several immature or incomplete specimens. Its affinities are uncertain. There is a superficial resemblance with the Recent Eastern Pacific *Cantharus pagodus* (Reeve) (Conch. Icon., vol. 3, *Buccinum*, pl. 7, species 50, 1846) which is a rare species ranging from Mazatlan to Panama according to Keen (1958, p. 401). *C. pagodus* has more inflated whorls, stronger axials, but no noded shoulder on the body whorl.

Occurrence. — K 8399, K 12255, PJ 212, USGS 10991, USGS 20432, USGS 21778.

Genus **CANTHARUS** Röding

Röding, 1798, in *Museum Boltenianum*, pt. 2, p. 132.

Type species (by subsequent designation, Cossmann, 1889, *Ann. Soc. Roy. Malac. Belgique*, vol. 24, p. 137), *Cantharus globularis* Röding (= *Buccinum tranquebaricum* Gmelin).

Cantharus (subgenus ?) species A

Pl. 54, figs. 5, 6

Of medium size. Spire high. Protoconch only partly preserved. Postnuclear whorls $6\frac{1}{2}$. Early whorls with nine, late whorls with seven to eight strong axial ribs. Early whorls evenly convex; their axials crossed by five spirals. Subsequently two spirals become more prominent than the others, the upper one forms a shoulder. Below these two spirals there are two minor ones; above them there are four spirals of unequal size. Outer lip thin, with many lirae within. Inner lip with a prominent callus with many somewhat irregular lirations. Siphonal fasciole moderately prominent. Siphonal canal short, slightly recurved.

This species is represented from the base of the Melajo Clay by one almost complete shell and one fragmentary specimen. It has some resemblance to the Recent Western Atlantic *C. multangulus* (Philippi) (see Robertson, 1957, p. 2). The Melajo form has stronger spirals and axials and is somewhat more slender. *C. multangulus* has a more inflated body whorl and lacks the prominent parietal callus. The strength of the spirals is more like that of the Recent Eastern Pacific *Pseudoneptuncea panamica* Hertlein and Strong [1940-1951 (1951), p. 81, pl. 2, figs. 6, 10].

Occurrence.—USGS 18634.

Genus **HANETIA** Jousseau

Jousseau, 1880, *Le Naturaliste*, 2d year, No. 42, p. 335.

Type species (by original designation and tautonymy), *Murex haneti* Petit de la Saussaye.

Hanetia semiglobosa (Guppy)

- 1911. *Solenosteira semiglobosa* Guppy, *Proc. Agric. Soc. Trinidad and Tobago*, Soc. Paper No. 454, pp. 4, 7, pl. 2, figs. 5, 6; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, pp. 161, 163, pl. 8, figs. 5, 6.
- 1911. *Solenosteira cochlearis* Guppy, *ibidem*, pp. 4, 7, pl. 2, fig. 3; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, pp. 161, 164, pl. 8, fig. 3.
- 1925. *Solenosteira semiglobosa* Guppy, Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 209, pl. 36, fig. 1.
- 1925. *Solenosteira cochlearis* Guppy, Maury, *ibidem*, p. 210, pl. 36, fig. 3.

1925. *Solenosteira semiglobosa* Guppy, Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 44.
1926. *Solenosteira semiglobosa* Guppy, Harris in Waring, Johns Hopkins Univ., Studies in Geol., No. 7, p. 110, pl. 20, figs. 5, 6.
1938. *Solenosteira semiglobosa* Guppy, Vokes, Amer. Museum Novitates, No. 988, p. 4.
1938. *Solenosteira semiglobosa cochlearis* Guppy, Vokes, *ibidem*, p. 4.
1942. *Cantharus (Hanetia) semiglobosus* (Guppy), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 151, pl. 7, figs. 8, 10.
1942. *Cantharus (Hanetia) semiglobosus cochlearis* (Guppy), Rutsch, *ibidem*, p. 152, pl. 7, figs. 9a, 9b.

Type. — The type specimen of this species is not in the U.S. National Museum.

Type locality. — Springvale Quarry, Trinidad.

H. semiglobosa occurs at the base of the Melajo Clay. Its variation as to height of spire and inflation of the body whorl has been emphasized by Rutsch. Even the few Melajo specimens at hand show this variability to some degree.

The rounded axial ribs of *H. semiglobosa* are inconspicuous and usually restricted to the early spire whorls. If they persist to the body whorl, they are poorly and somewhat irregularly developed. A single specimen from the late Miocene Punta Gavilán Formation of Venezuela, probably representing *H. semiglobosa*, has been recorded by Rutsch (1934, p. 72, pl. 5, fig. 1).

In *H. gavilanensis* (Rutsch) (1934, p. 71, pl. 4, figs. 14-17) from the Punta Gavilán Formation of Venezuela, as well as in *H. magdalenensis* (Weisbord) (1929, p. 46, pl. 6, figs. 16, 17) from the middle Miocene of Colombia, the axials persist to the body whorl. *H. magdalenensis* and *H. semiglobosa* both have more axials and coarser spirals than *H. gavilanensis*.

The Pliocene *H. boggsi* Pilsbry and Olsson (1911, p. 28, pl. 5, figs. 3, 4) from Ecuador has more axials than *H. semiglobosa*. *H. boggsi* is related to the Recent Eastern Pacific *H. anomala* (Reeve).

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad. Punta Gavilán Fm. (late Miocene), Venezuela ?

Genus **CALOPHOS** Woodring

Woodring, 1964, U. S. Geol. Sur., Prof. Paper 306-C, p. 262.

Type species (by original designation). *Calophos ectyphus* Woodring.

Calophos rohri (Rutsch)

Pl. 54, figs. 7-10

1942. *Phos ? rohri* Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 150, pl. 7, figs. 5, 6.

Of medium to large size. Protoconch consists of almost two smooth whorls. Postnuclear whorls seven. Early sculpture reticulate. The axials disappear entirely after a few whorls, and the spirals become flatter. The spirals are absent on the middle portion of the body whorl or on the lower part of the penultimate whorl. Outer lip thin, with long lirations within. Inner lip smooth. Siphonal fasciole sculptured by four to six spirals, the uppermost one more prominent.

Holotype. — Natural History Museum Basel, No. H 6187.

Type locality. — Brechin Castle Estate, Trinidad (see Rutsch, 1942, p. 105, fig. 1).

The holotype of *C. rohri* is immature. Its last whorl still has spirals. Topotypes and other specimens from the Savaneta Glauconitic Sandstone Member of the Springvale Formation are not well preserved. In fact most specimens are deformed, whereas the shells from the Melajo Clay are almost perfect. Adult specimens of *C. rohri* are rare and fragmentary in the type area. In adult specimens the last part of the suture behind the outer lip is slightly ascending, but this part of the shell is rarely preserved.

The early sculpture of *C. rohri* is somewhat variable. The axials disappear sooner or later. The strength and width of the spirals are also variable. The spire is usually somewhat concave in profile.

C. rohri is most closely related to *C. baranoanus* (Anderson) (1929, p. 137, pl. 16, figs. 4, 5) from the middle Miocene of Colombia. *C. baranoanus* may have a thick shell. On an average its whorls are more convex, and its general shape stouter. Olsson (1964, p. 162, pl. 20, fig. 1) included *C. baranoanus* in his genus *Gordanops* (type species by original designation: *Gordanops esmeraldensis* Olsson). As mentioned above *C. rohri* has also a slightly ascending suture near the outer lip, but even less so than *C. baranoanus*.

C. mixteca (Perrilliat) (1963, p. 21, pl. 4, figs. 16, 17) from the middle Miocene Agueguexquite Formation, Isthmus of Tehuantepec, Mexico, is a smaller and more slender species. Its spirals disappear earlier than in *C. rohri*. Obscure axials may be present on the body whorl which are always lacking in *C. rohri* and *C. barano-*

anus. The type species of *Calophos*, *C. ectyphus* Woodring (1961, p. 263, pl. 42, figs. 12, 13, 16, 17) from the middle Miocene Gatun Formation of Panama, has even more prominent axials on the body whorl than *C. mixteca*.

Occurrence. — Hutch 47, Hutch 51, EL 1810, K 9797, RR 290, PJ 285, USGS 18399, USGS 18634, USGS 21178.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Genus **METAPHOS** Olsson

Olsson, 1964, Neogene Mollusks from Northwestern Ecuador, p. 154, Paleont. Research Inst.

Type species (by original designation), *Phos chelonia* Dall.

Metaphos (?) species Pl. 54, figs. 11, 12

Of medium size, slender. Spire high. Protoconch with four whorls. Postnuclear whorls $6\frac{1}{2}$. First sculpture consists of fine spirals. After half a whorl these are crossed by opisthocline axials which gradually become orthocline. Early sculptured whorls somewhat shouldered but less so later. Axials sharply defined on early whorls but broader and rounded on late whorls. There are 11 axials on the body whorl. Number of spirals increasing with age, flattened on last whorl. Edge of outer lip not preserved; with fine lirations on inner surface. Columella smooth except for a basal fold which is followed by a shallow depression. Siphonal canal moderately short. Siphonal fasciole bordered by a sharp ridge.

This form is represented by two incomplete specimens from the Courbaril beds. Its generic assignment is questionable. It is not close to any of the species described by Olsson (1964, pp. 154-156). The Recent Eastern Pacific *Phos cocosensis* Dall (1896, p. 11) is considerably larger, and its axials do not become broader on late whorls.

Occurrence. — USGS 21778.

Genus **METULA** H. and A. Adams

H. and A. Adams, 1853, Genera of Recent Mollusca, vol. 1, p. 84.

Type species (by hidden tautonymy), *Metula hindsii* H. and A. Adams (= *Buccinum metula* Hinds).

Metula aff. **cancellata** Gabb

Pl. 55, fig. 1

Of medium size, slender. Protoconch not preserved. Postnuclear

whorls $5\frac{1}{2}$. First sculpture consists of six spirals which are crossed by numerous fine axials. Subsequently the axials become stronger than the spirals, and additional spirals are intercalated. On late spire whorls the spirals do not cross the axials with the exception of three spirals near the upper suture. On the body whorl axials and spirals are of almost the same size. Aperture long. Outer lip thickened, with numerous short denticles on inner surface. Columellar callus prominent, smooth.

This form is represented by a single, damaged specimen from the Melajo Clay. The type of *M. cancellata* Gabb (1873b, p. 205; Pilsbry, 1922, p. 349, pl. 22, figs. 19, 20) from the middle Miocene Gurabo Formation of the Dominican Republic has similar proportions and about the same size. In fact it differs only in having a somewhat finer sculpture.

An unnamed form occurring in deposits of late Miocene age near Puerto Limón, Costa Rica (USGS locality 18693) — not *M. limonensis* Olsson (1922, p. 116, pl. 10, figs. 5, 6) which is a stouter species with coarser sculpture than the Melajo shell — is probably conspecific with the Melajo specimen. As small species from the Pliocene of Moín Hill, Costa Rica (USGS locality 21051) has been recorded by Gabb (1881b, p. 351, pl. 46, fig. 32) as *M. cancellata*.

As pointed out by Woodring (1928, p. 286; 1964, p. 259) the status of *M. lintea* Guppy is uncertain.

Occurrence. — USGS 21178.

Family **NASSARIIDAE**

Genus **PALLACERA** Woodring

Woodring, 1964, U. S. Geol. Sur., Prof. Paper 306-C, p. 269.

Type species (by original designation), *Nassa myristicata* Hinds.

Pallacera species A

Pl. 55, figs. 2, 3

Of medium size, solid. Protoconch missing. Sculpture consists of prominent, rounded axials with wide interspaces and fine, closely spaced, spiral threads. There are eight axials on early whorls, six on body whorl. Whorls somewhat shouldered. Outer lip with long lirations on inner surface. Siphonal fasciole prominent.

A single, somewhat worn shell with a little more than four whorls from the base of the Melajo Clay is available. It closely

resembles the probably immature specimen from the middle Miocene Gatun Formation of the Panama Canal Zone recorded by Woodring (1964, p. 270, pl. 43, figs. 2, 6) as *P. aff. guadelupensis* (Petit). The axials of the Gatun specimen are more regularly aligned on successive whorls than those of the Melajo shell.

Occurrence. — USGS 18411.

Pallacera cf. **guadelupensis** (Petit de la Saussaye)

A single fragment from Matura suggests the Recent West Indian *P. guadelupensis* (Petit de la Saussaye) (1852, p. 56, pl. 2, figs. 3, 4). It consists of the body whorl only but shows the apertural features and the siphonal fasciole typical of *Pallacera*. The Matura fragment has seven axials on the body whorl. *P. guadelupensis* has more of them. The same is true of *P. solidula* (Guppy) (1866b, p. 579, pl. 26, fig. 11) from Cumaná, Venezuela.

Occurrence. — USGS 19860.

Genus **NASSARIUS** Duméril

Duméril, 1806, *Zoologie analytique*, p. 166 (genus without species).

Type species (by monotypy, Froriep, 1806, C. Duméril's *analytische Zoologie*, p. 167), *Buccinum arcularia* Linné (see Iredale, 1916, *Malac. Soc. London, Proc.*, vol. 12, p. 83).

Subgenus **PHRONTIS** H. and A. Adams

H. and A. Adams, 1853, *The Genera of Recent Mollusca*, vol. 1, p. 117.

Type species (by subsequent designation, Cossmann, 1901, *Essais de paléoconchologie comparée*, pt. 4, p. 207), *Nassa tiarula* Kiener.

Nassarius (Phrontis) vibex (Say)

Pl. 55, figs. 4, 5

1822. *Nassa vibex* Say, *Acad. Nat. Sci. Philadelphia, Jour.*, ser. 1, vol. 2, p. 231.

1962. *Nassarius (Phrontis) vibex* (Say), Weisbord, *Bull. Amer. Paleont.*, vol. 42, No. 193, p. 349, pl. 30, figs. 13, 14. For further citations see this publication.

This species is represented by two specimens from the Courbaril beds. They are somewhat smaller than Recent shells, and their spiral sculpture is finer.

Occurrence. — K 1429, USGS 10991.

Distribution. — Widespread from late Miocene to Recent (see Weisbord, 1962, p. 351).

Subgenus **UZITA** H. and A. Adams

H. and A. Adams, 1853, *The Genera of Recent Mollusca*, vol. 1, p. 120.

Type species (by subsequent designation, Cossmann, 1901, *Essais de paléoconchologie comparée*, pt. 4, p. 205), *Buccinum migum* Bruguière.

Nassarius (Uzita) trinitatensis, n. sp.

Pl. 55, figs. 6-8

Shell small, solid, stout. Protoconch consists of three smooth whorls. Early sculpture with spirals and axials of almost equal strength. Subsequently the axials become much stronger and rounded. On the body whorl there are about 11 axials exclusive the terminal varix, but they are narrower and more closely spaced behind the outer lip. Sutures usually deep, giving a somewhat angulated appearance to the whorls. There are five to six spirals on the penultimate whorl. On the body whorl there are occasional secondary spirals between the primaries. Outer lip thick, with a few elongate denticles on inner surface. Parietal callus prominent, its border detached from pillar; with a tooth posteriorly bordering a short posterior canal. Base of columella with a few rugae. Fossa deep. Siphonal fasciole with four to six spirals.

Holotype. — Natural History Museum Basel, No. H 15221.

Dimensions of holotype. — Height 9.3 mm, greatest diameter 5.3 mm.

Type locality. — Melajo River area: PJ 285.

N. trinitatensis occurs in great numbers in the Melajo Clay and in the Courbaril beds, and shows a considerable variation as to apical angle, number of spirals, and prominence of suture. The Courbaril shells tend to have somewhat broader axials.

N. trinitatensis is most closely related to *N. gurabensis* (Maury) (1917, p. 91, pl. 15, fig. 21) from the middle Miocene Gurabo Formation of the Dominican Republic. Both species have the same type of sculpture and a similar degree of variation. *N. gurabensis* usually has more numerous and finer spirals on the middle part of the body whorl. The aperture of *N. gurabensis* is more rounded, whereas that of *N. trinitatensis* is pointed above, i.e. its posterior canal is narrower.

N. brassicus (Maury) (1925, p. 210, pl. 36, fig. 12) and *N. brassoensis* (Mansfield) (1925, p. 46, pl. 7, fig. 3), both from the

Brasso Formation of Trinidad, have been considered as synonyms of *N. cercadensis* (Maury) (1917, p. 90, pl. 15, figs. 19, 20) from the middle Miocene Cercado Formation of the Dominican Republic by Woodring (1964, p. 271). Although similar in sculpture to *N. trinitatensis*, *N. cercadensis* mainly differs by its smaller size.

Occurrence.—Melajo River area: Hutch 47, EL 1810, KR 11862, K 9797, K 9817, K 9903, RR 293, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, USGS 10991, USGS 20432, USGS 20434.

Nassarius (Uzita) cf. albus (Say)

- 1864. *Nassa incrassata* ? Müller, Guppy, Trans. Sci. Assoc. Trinidad for 1864, p. 34; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 14.
- 1867. *Nassa incrassata* Müller, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 158 (part); reprint, Harris, 1921, *ibidem*, p. 37.
- 1874. *Nassa incrassata* Müller, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 439 (part).

The *Nassarius* cited by Guppy from Matura long ago is represented in the present collections by a few poor, mostly incomplete specimens. The largest specimen available is still smaller than Recent adults of *N. albus*. As stated by Abbott (1958, p. 75, pl. 3 r) *N. albus* is a strongly variable species.

Occurrence.—JS 67, RR 230, PJ 302, USGS 19860.

Nassarius (Uzita) species A

Pl. 55 figs. 9, 10

Of medium size. Protoconch consists of almost four whorls, its last part sculptured by slightly opisthocytic axials. The axials soon become orthocone and are crossed by numerous fine spirals. Late spire whorls are slightly shouldered, and the spiral sculpture becomes obsolete except near the upper suture. Body whorl with nine axials exclusive terminal varix. Outer lip with lirations on inner surface. Posterior canal small. Parietal callus heavy, with denticles on lower part, and more or less prominent pustules on upper part. Fossa deep. Siphonal fasciole sculptured by a few spirals and sigmoid growth lines.

This form is represented by a few specimens from the base of the Melajo Clay. It suggests a relationship with the Recent Western Atlantic *N. consensus* (Ravenel) (1861, p. 43). The apertural features are the same, but the apical angle is smaller in the Melajo specimens. The spiral sculpture of *N. consensus* has about the same strength on all the whorls, whereas in Melajo shells it is

stronger on early whorls but weaker on late whorls. According to Abbott (1954, p. 239, fig. 53b) *N. consensus* may be a form of *N. albus*.

N. fargoi Olsson and Harbison (1953, p. 223, pl. 33, fig. 3) from the Pliocene of Florida is considered by its authors as the precursor of *N. consensus*.

Occurrence. — USGS 18411, USGS 18634.

Nassarius (subgenus ?) **galbanus**, n. sp.

Pl. 55, figs. 11, 12

Of small to medium size. Protoconch with $2\frac{3}{4}$ smooth whorls. Early sculpture consists of three or four fine spirals which are soon crossed by straight axials. Subsequent whorls with heavy axials but obsolete spiral sculpture. Each axial divided into three parts by two constrictions. Body whorl with 12 axials exclusive terminal varix. Axials crossed by several spiral grooves on lower part of body whorl. Outer lip with about five denticles on inner surface. Inner lip with a denticle bordering the short posterior canal and an indistinct pustule near the base of the columella. Fossa missing. Siphonal fasciole not prominent, sculptured by a few nodulose spirals.

Holotype. — Natural History Museum Basel, No. H 15235.

Dimensions of holotype. — Height 7.7 mm, greatest diameter 4.1 mm.

Type locality. — Point Courbaril: K 1429.

N. galbanus occurs in the Courbaril beds only, where it is represented by more than 40 specimens.

N. galbanus is characterized by its predominantly axial sculpture and the lack of a fossa. The same general features are shown by *Nassa fontainei* d'Orbigny, the lectotype of which has been figured by Keen (1966, p. 4, pl. 1, fig. 3), and *Nassa panamensis* C. B. Adams (1852, p. 288; Turner, 1956, p. 71, pl. 5, fig. 9). These two species are considered as synonyms of *N. exilis* (Powys) (in G. B. Sowerby I and Powys, 1835, p. 95) by Keen (1958, p. 409). *N. galbanus* is considerably smaller than the West American species and differs in details of sculpture.

Occurrence. — K 1429, K 8399, PJ 212, USGS 10991, USGS 20432, USGS 20434.

Family **MELONGENIDAE**

Genus **MELONGENA** Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, pp. 61, 212.

Type species (by monotypy), *Melongena fasciata* Schumacher (= *Murex melongena* Linné).

Melongena melongena (Linné)

Pl. 56, figs. 1, 2

1758. *Murex melongena* Linné, Systema Naturae, ed. 10, p. 751.

1956. *Melongena melongena* (Linné), Clench and Turner, Johnsonia, vol. 3, No. 35, p. 165, pls. 96, 98.

1962. *Melongena melongena* (Linnaeus), Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 345, pl. 30, figs. 11, 12. For further citations see this publication.

M. melongena occurs in the Courbaril beds. Only three immature specimens and a piece of the wall of the body whorl of an adult shell are available. The fragment bears two spines of the row on the lower part of the body whorl. This row is mostly lacking in the Recent Eastern Pacific *M. patula* (Broderip and G. B. Sowerby I) (Clench and Turner, 1956, p. 168, pl. 99). The suture of the immature shells is deeply channeled. It is slightly ascending on the last part of the last preserved whorl which marks the beginning of the partial immersion of the spire so characteristic for Recent adult shells of *M. melongena*. The early spire whorls are shouldered but not so strongly angulated as in *M. patula*.

Occurrence.—K 8399, PJ 212, USGS 20432, USGS 21778.

Distribution.—See Clench and Turner (1956, pp. 167, 168) and Weisbord (1962, p. 348).

Family **FASCIOLARIIDAE**Genus **LATIRUS** Montfort

Montfort, 1810, Conchyliologie systématique, vol. 2, p. 531.

Type species (by original designation), *Latirus aurantiacus* Montfort (= *Murex gibbulus* Gmelin).

Subgenus **POLYGONA** Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, p. 241.

Type species (by monotypy), *Polygona fusiformis* Schumacher (= *Murex infundibulum* Gmelin).

Latirus (Polygona) cf. infundibulum (Gmelin)

Two poorly preserved, incomplete specimens from the base of the Melajo Clay are at hand. The strength of the sculpture is intermediate between the Recent Western Atlantic *L. infundibulum* and

L. infundibulum polius Woodring (1928, p. 253, pl. 15, figs. 4, 5) from the Bowden Formation of Jamaica. Specimens from the Savaneta Glauconitic Sandstone Member of the Springvale Formation have been identified as *L. infundibulum* by Rutsch (1942, p. 153) and as *L. infundibulum* cf. *polius* by Vokes (1938, p. 23, fig. 24).

Occurrence. — USGS 18634.

Genus **FASCIOLARIA** Lamarek

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 73.

Type species (by monotypy), *Murex tulipa* Linné.

Fasciolaria cf. **tulipa** (Linné)

Two poorly preserved fragments from Matura seem to be identical or at least closely related to the Recent Western Atlantic *F. tulipa*. They are immature, the larger one measuring about 55 mm in height. No protoconch is preserved. The upper half of the whorls is slightly concave and is sculptured by stronger spirals than the rest of the whorl. The two columellar folds conspicuous.

On an average the apical angle of Recent shells is somewhat smaller than that of the Matura specimens.

Occurrence. — JS 67, RR 230.

Subgenus **PLEUROPLOCA** Fischer

Fischer, 1884, Manuel de conchyliologie, p. 616.

Type species (by monotypy), *Murex trapezium* Linné.

Fasciolaria (Pleuroploca) turamensis, n. sp.

Pl. 56, figs. 4-6

Of small to medium size. Protoconch large, consists of about one whorl. Postnuclear whorls almost five. First sculpture consists of axials. After less than one whorl they disappear and are replaced by spirals of varying strength. At the same time the apical angle becomes larger, and the whorls slightly shouldered. Shoulder of body whorl prominent, carrying rounded nodes. Area between shoulder and upper suture somewhat concave, sculptured by widely spaced spirals. Spiral sculpture below shoulder obsolete but stronger again near base. Growth lines prosocline above shoulder, almost orthocline below. Outer lip with long, fine lirations on inner surface. Columellar callus thin, with a small ridge posteriorly which reaches far into the aperture. Siphonal canal moderately long. Siphonal fasciole inconspicuous.

Holotype. — Natural History Museum Basel, No. H 15243.

Dimensions of holotype. — Height 56.3 mm, greatest diameter 28.5 mm.

Type locality. — Matura Bay: RR 230.

This species is represented by two specimens from Matura. The front of the holotype is broken, but the protoconch is preserved and the anterior canal complete. The inner surface of the outer lip of the only paratype is encrusted by small oysters. Both specimens are probably not adult.

F. turamensis, n. sp. is most closely related to the Recent Eastern Pacific species or group of species listed by Keen (1958, p. 114) as *F. granosa* Broderip (in Broderip and G. B. Sowerby I, 1832-1833, p. 32, 1832) and *F. salmo* (Wood) (Supplement to the Index Testaceologicus, p. 51, pl. 5, fig. 14). Immature shells of about the same size as the Matura specimens tend to have more strongly shouldered early spire whorls (although this feature is variable in the Recent form). *F. turamensis*, however, has a considerably larger protoconch. In addition its spirals above the shoulder are widely spaced and not crowded as in the Recent shells. The growth lines above the shoulder are much more prosocline in the Matura species.

The body whorl of the Pliocene Venezuelan *F. crassinoda* Weisbord (1962, p. 354, pl. 31, figs. 3, 4) is more inflated and more constricted below than that of the Recent Eastern Pacific form. Its early spire whorls are more shouldered than those of *F. turamensis*. According to the original description *F. crassinoda* has a different protoconch.

Occurrence. — RR 230.

Family FUSINIDAE

Genus FUSINUS Rafinesque

Rafinesque, 1815, *Analyse de la Nature*, p. 145 (= *Fusus* Lamarck, 1799, not *Fusus* Helbling 1779).

Type species (of *Fusus* Lamarck, by monotypy), *Murex colus* Linné.

Fusinus species

Pl. 56, fig. 3

Of medium size. Protoconch consists of $1\frac{3}{4}$ whorls, its last part sculptured by closely spaced, straight axials. First sculpture of four spirals and widely spaced axials. On subsequent whorls three spirals become more prominent, and additional spirals of secondary size

are intercalated. The area above the strong spirals tends to be concave. There are 10 low axials on the last preserved whorl. Inner surface of outer lip with strong lirations. Canal sculptured by spirals of alternating size.

A few specimens from the base of the Melajo Clay are available. The size of a fragment of an anterior canal suggests that the other specimens are immature.

The axials of *F. springualensis* (Maury) (1925, p. 206, pl. 35, fig. 11) from the Savaneta Glauconitic Sandstone Member of the Springvale Formation disappear on about the fifth spire whorl. In the Melajo species they decrease in strength on late spire whorls but do not disappear.

The *Fusinus* described by Woodring (1928, p. 257, pl. 15, fig. 8) from Bowden, Jamaica, has the same type of sculpture as the Melajo form, but is more slender, and has stronger axials, but weaker spirals. An almost complete specimen (USNM 559572) of the Bowden *Fusinus* referred to above is now available. Its straight, narrow anterior canal is as long as the spire.

Occurrence. — USGS 18411, USGS 18634.

Fusinus cf. henekeni¹ (Sowerby)

A single, incomplete specimen (height 86 mm)' from Matura is available. It is related to the group of *F. henekeni* (G. B. Sowerby II) (1850, p. 49; Pflug, 1961, p. 47, pl. 12, figs. 1-5, 7, 9, 10) from the middle Miocene Cercado and Gurabo Formations of the Dominican Republic.

The whorls of the Matura specimen are regularly rounded. There are 10 low, rounded axials on the last preserved whorl which are crossed by spirals of two magnitudes. The axials of *F. esmeraldus* Olsson (1961, p. 143, pl. 24, figs. 3-3b) from the late Miocene or early Pliocene Esmeraldas Formation of Ecuador are heavier and broader. The axials of the Recent *F. eucosmius* (Dall) (1889a, p. 167, pl. 35, fig. 5) are more prominent and the whorls more constricted.

Occurrence. — RR 230.

Family OLIVIDAE

Genus OLIVA Bruguière

Bruguière, 1789, Encyclopédie méthodique, Histoire naturelle des vers, vol. 1, p. xv (genus without species).

¹Originally inadvertently spelled *henikeri*, named for Colonel Heneken.

Type species (by monotypy and tautonymy, Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 70), *Voluta oliva* Linné.

Subgenus **OLIVA** s. str.

Oliva (Oliva) couvana Maury

Pl. 56, fig. 8

1910. *Oliva cylindrica* Sowerby, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 6; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 149.
1925. *Oliva cylindrica* Sowerby, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 195, pl. 33, figs. 3, 5.
1925. *Oliva couvana* Maury, *ibidem*, p. 195, pl. 33, fig. 6.
1938. *Oliva (Oliva) cylindrica* Sowerby, Vokes, Amer. Museum Novitates, No. 988, p. 4.
1938. *Oliva (Oliva) couvana* Maury, Vokes, *ibidem*, p. 4.
1942. *Oliva plicata couvana* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 157, pl. 8, fig. 4.

Holotype. — Paleont. Research Inst., Ithaca, N. Y., No. 1021.

Type locality. — Springvale Quarry, Trinidad.

O. couvana is represented by a few specimens from the base of the Melajo Clay. The close relationships of this species to *O. cristobalcoloni* Maury (1917, p. 67, pl. 10, fig. 15) from the middle Miocene Ceracado and Gurabo Formations of the Dominican Republic and *O. tuberaensis* Anderson (1929, p. 128, pl. 17, figs. 2, 3) from the middle Miocene of Colombia has been pointed out by Rutsch (1942, p. 158) and Woodring (1964, p. 278).

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Oliva trinidadensis Maury

Pl. 56, fig. 7

1912. *Oliva trinidadensis* Maury, Acad. Nat. Sci. Philadelphia, Jour., ser 2, vol. 15, p. 67, pl. 10, fig. 4.

Lectotype (herewith selected). — Cornell University, Paleont. Museum, Ithaca, N. Y., unnumbered.

Dimensions of lectotype. — Height 14.2 mm, diameter 7.8 mm.

Type locality. — Southern Main Road, at 56¾ milepost (today 49¾) just south of Pitch Lake, Trinidad. Stratigraphically this locality is about equivalent to the Courbaril beds.

The lectotype is preserved as an internal mold attached to matrix. The number of recognizable characters is insufficient to determine relationships. *Oliva trinidadensis* should be considered as a *nomen dubium*.

Genus **JASPIDELLA** Olsson

Olsson, 1956, Acad. Nat. Sci. Philadelphia, Proc., vol. 108, p. 212.

Type species (by original designation), *Voluta jaspidea* Gmelin.

Jaspidella sanctidominici (Maury)

Pl. 55, fig. 21

1917. *Olivella sanctidominici* Maury, Bull. Amer. Paleont., vol. 5, No. 29, p. 69, pl. 11, fig. 4.

Of medium size, solid. Protoconch not well separated from later whorls, consists of less than one volution, large. Postnuclear whorls a little more than three, highly polished. Spire low. Suture channeled. Columella with a heavy basal fold and a few indistinct denticles above.

Holotype. — Cornell University, Paleont. Museum, Ithaca, N.Y.

Type locality. — Río Gurabo at Los Quemados, Dominican Republic (Gurabo Fm.).

This species is represented by a single well-preserved specimen from the base of the Melajo Clay. It is indistinguishable from topotypes of *J. sanctidominici* except that its protoconch is slightly lower. Two specimens from Springvale Quarry (USGS locality 21809) are somewhat deformed, but seem to represent the same species.

As pointed out by Maury *J. sanctidominici* has a lower spire than the Recent West Indian *J. jaspidea* (Gmelin) (Olsson, 1956, p. 212, pl. 15, figs. 1, 1a) and is somewhat more slender.

Occurrence. — USGS 18411.

Distribution. — Gurabo Fm. (middle Miocene), Dominican Republic. Savaneta Glauconitic Sandstone Member (?) and Melajo Clay Member, both of Springvale Fm., Trinidad.

Genus **OLIVELLA** Swainson

Swainson, 1831, Zoological Illustrations, ser. 2, vol. 2, explanation of pl. 58 (*Oliva*, pl. 2).

Type species (by subsequent designation, Dall, 1909, U.S. Geol. Sur., Prof. Paper 59, p. 31), *Oliva purpurata* Swainson (= *Voluta dama* Mawe).

Subgenus **OLIVELLA** s. str.**Olivella** (**Olivella**) species

Pl. 55, fig. 13

Shell small. Protoconch small. Postnuclear whorls about four. Sutures deeply channeled. Columellar callus with four to five

elongate denticles. Parietal callus with two rather distant denticles. Columella more or less excavated.

This form is fairly common at Matura, but the specimens seem to be immature. It possibly represents the species listed by Maury (1925, p. 197; not pl. 33, fig. 2) as *Olivella mutica*. The columellar excavation is not always pronounced. The strength of the denticles near the base is variable. The Matura species is much smaller than the Recent Western Atlantic *O. nivea* (Gmelin) (Olsson, 1956, p. 172, pl. 11, figs. 3-3b).

Occurrence. — JS 67, RR 230, PJ 302, USGS 19860.

Subgenus **DACTYLIDIA** H. and A. Adams

H. and A. Adams, 1853, The Genera of Recent Mollusca, vol. 1, p. 146.

Type species (by subsequent designation, Cossmann, 1899, Essais de paléoconchologie comparée, pt. 3, p. 51), *Oliva mutica* Say.

Olivella (Dactylidia) aff. mutica (Say)

Pl. 55, fig. 14

Of small to medium size. Protoconch not well separated from later whorls, consisting of about $11\frac{1}{2}$ whorls. Postnuclear whorls up to $4\frac{1}{2}$. Sutures deeply channeled. Parietal callus prominent. Pillar structure consists of a tongue-shaped ledge bearing a basal fold and several lirations above. Fasciolar band with a broad lower and a narrow upper part.

This species is represented by some specimens from the Melajo Clay. The same form occurs in the Savaneta Glauconitic Sandstone Member of the Springvale Formation.

The Recent Western Atlantic *O. mutica* (Say) (1822, p. 228; Olsson, 1956, p. 184, pl. 9, figs. 7-7b) essentially is a larger and stouter species with a larger initial whorl. It also differs in details of the pillar structure.

Occurrence. — EL 1810, KR 11862, K 9797, PJ 285, USGS 21178.

Subgenus **NITEOLIVA** Olsson

Olsson, 1956, Acad. Nat. Sci. Philadelphia, Proc., vol. 108, p. 189.

Type species (by original designation), *Porphyria minuta* Link.

Olivella (Niteoliva) cf. verreauxi (Ducros)

Pl. 55, fig. 15

A few worn and mostly immature specimens from Matura are

close to the Recent Caribbean *O. verreauxi* (Ducros) (Olsson, 1956, p. 191, pl. 9, fig. 3). The largest Matura shell is figured. It is incomplete and considerably smaller than Recent specimens. As pointed out by Olsson *O. verreauxi* is more slender than *O. minuta* (Link).

Occurrence.—JS 67, RR 230, PJ 302, USGS 19860.

Subgenus **MINIOLIVA** Olsson

Olsson, 1956, Acad. Nat. Sci. Philadelphia, Proc., vol. 108, p. 209.

Type species (by original designation), *Olivella (Minioliva) perplexa* Olsson.

Olivella (Minioliva) fundarugata Weisbord Pl. 55, figs. 16, 17

1962. *Olivella (Minioliva) fundarugata* Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 385, pl. 35, figs. 1-8.

1962. *Olivella (Minioliva) subfifera* Weisbord, *ibidem*, p. 386, pl. 35, figs. 9, 10.

Shell small. Protoconch consists of less than one whorl. Post-nuclear whorls about four. Sutures deeply channeled. Columella with an inconspicuous fold at base. Parietal callus thick near posterior end of aperture. Fasciolar band bordered by a fine spiral groove.

Holotype.—Paleont. Research Inst., Ithaca, N. Y., No. 26278.

Type locality.—Cabo Blanco area, Venezuela (Mare Fm.).

This species is represented in the Melajo Clay by several hundred specimens of all growth stages and by about 100 specimens from the Courbaril beds. They never exceed 4 mm in height. The height of the spire, the apical angle, as well as the stoutness of the body whorl, show a great variability. On some Melajo specimens the color pattern is preserved. It consists of closely set axial bands. The thickening of the parietal callus near the posterior end of the aperture, however, is constant. Only in young specimens with one or two postnuclear whorls it is not yet developed.

The type lot (USNM 214357) of the Subrecent to Recent *O. myrmecoon* Dall (1912, p. 4; Olsson, 1956, p. 211, pl. 12, figs. 10, 10a) from the Caribbean coast of the Panama Canal Zone consists of nine specimens. These shells also show some variability as to height of spire and apical angle. Some of them have retained a color pattern consisting of axial bands which are more widely spaced than in Melajo specimens. On an average *O. myrmecoon* is

stouter than the Melajo shells, and its parietal callus is not thickened near the posterior end of the aperture.

O. maiquetiana Weisbord (1962, p. 388, pl. 35, figs. 11-14) and *O. salinae* Weisbord (1962, p. 389, pl. 35, figs. 15, 16) are both based on immature specimens and may represent a known species.

Occurrence. — Melajo River area: EL 1810, KR 11862, RR 290, PJ 285, USGS 18399, USGS 21178. Point Courbaril: K 1429, PJ 212, USGS 10991, USGS 20433.

Distribution. — Pliocene of Cabo Blanco area, Venezuela.

Genus **ANCILLA** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 70 (genus without binominally named species).

Type species (by subsequent designation, Lamarck, 1801, *Système des animaux sans vertèbres*, p. 73), *Ancilla cinnamomea* Lamarck.

Subgenus **EBURNA** Lamarck

Lamarck, 1801, *Système des animaux sans vertèbres*, p. 78.

Type species (by monotypy), *Eburna flavida* Lamarck (= *Buccinum glabratum* Linné).

Ancilla (Eburna) caroniana Maury

- 1910. *Ancilaria lamelata* (sic) Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 10; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 153.
- 1911. *Ancilaria lamelata* (sic) Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 454, p. 9; reprint, Harris, 1921, *ibidem*, p. 165.
- 1925. *Ancilla caroniana* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 198, pl. 33, figs. 4, 10, 12.
- 1925. *Ancilla caroniana* Maury, Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 34, pl. 5, fig. 4.
- 1925. *Ancilla caroniana springvalensis* Mansfield, *ibidem*, p. 35, pl. 5, fig. 5.
- 1938. *Ancilla (Eburna) caroniana* Maury, Vokes, Amer. Museum Novitates, No. 988, p. 4.
- 1938. *Ancilla (Eburna) caroniana springvalensis* Mansfield, Vokes, *ibidem*, p. 4.
- 1942. *Ancilla (Eburna) caroniana* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 155, pl. 8, figs. 1, 3.
- 1942. *Ancilla (Eburna) caroniana springvalensis* Mansfield, Rutsch, *ibidem*, p. 156, pl. 8, fig. 2.

Types. — Lectotype of *A. caroniana* (herewith selected): Paleont. Research Inst., Ithaca, N. Y., No. 1025 (specimen figured by Maury, 1925, pl. 33, figs. 10, 12). Holotype of *caroniana springvalensis*: USNM 352666.

Dimensions of lectotype of caroniana. — Height 60.4 mm, diameter 28.7 mm.

Type locality. — For both forms: Springvale Quarry, Trinidad.

A. caroniana is represented by two incomplete specimens from the base of the Melajo Clay. In the Savaneta Glauconitic Sandstone Member *A. caroniana* is abundant, and all transitions from *A. caroniana* to Mansfield's subspecies *springvalensis* are represented. The Melajo specimens have an acute spire with flat-sided whorls.

A. caroniana has a distinct spiral line just above the middle of the body whorl which meets the parietal callus above the aperture. This line is absent in the type species of *Eburna*, the Recent West Indian *A. glabrata* (Linné) as well as in *A. glabrata speciosa* Rutsch (1934, p. 78, pl. 5, figs. 6, 7, text fig. 10) from the late Miocene Punta Gavilán Formation of Venezuela.

Maury's (1925, p. 199) record of *A. caroniana* from the middle Miocene Manzanilla Formation has not been confirmed.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Family MITRIDAE

Genus **CANCILLA** Swainson

Swainson, 1840, A treatise on malacology, pp. 130, 320.

Type species (by subsequent designation, Herrmannsen, 1846, *Indicis generum malacozoorum primordia*, vol. 1, p. 166), *Mitra isabella* Swainson. See Coan (1966, p. 129).

Cancilla cf. **sanctifrancisci** (Maury)

A fragment from the base of the Melajo Clay, consisting of a single late whorl, seems to belong to *C. sanctifrancisci* (Maury) (1925, p. 204, pl. 35, fig. 13) which had been described from the Savaneta Glauconitic Sandstone Member of the Springvale Formation. Its sculpture consists of five spirals without secondary spirals in its interspaces and fine axials.

Some small specimens, also from the base of the Melajo Clay, include well-preserved early stages. The protoconch is high, and consists of $3\frac{1}{2}$ whorls. Sculpture starting abruptly, consists of four closely set spirals and weak axials in the interspaces. On later whorls the two central spirals are somewhat stronger than the others. Columella with three strong folds, below which there may be one or two smaller ones.

It is questionable whether these immature specimens represent *C. sanctifrancisci*. Rutsch (1942, pl. 8, figs. 6a, 6b) figured a much better specimen than Maury (1925, pl. 35, fig. 13) and included *Mitra woodringi* Vokes (1938, p. 22, fig. 15) in the synonymy of *C. sanctifrancisci*. The early whorls of the Melajo shells are more convex than those of specimens from Springvale.

Occurrence. — USGS 18411, USGS 18634.

Genus **SCABRICOLA** Swainson

Swainson, 1840, A treatise on malacology, pp. 130, 131, 319.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 141), *Mitra serpentina* Lamarck.

According to Cernohorsky (1966, p. 116) *Mitra serpentina* is the same as *Voluta variegata* Gmelin, and its radula "unique among all other mitrid radula types."

Scabricola nodulosa (Gmelin)

Pl. 55, fig. 18

1791. *Voluta nodulosa* Gmelin, Systema Naturae, ed. 13, vol. 1, pt. 6, p. 3445.

1962. *Mitra (Uromitra) nodulosa* (Gmelin), Weisbord, Bull. Amer. Paleont., vol. 42, No. 193, p. 395, pl. 36, figs. 7, 8. For further citations see this publication.

A single, worn, not adult specimen from Matura is available. It is indistinguishable from Recent shells of corresponding size. As stated by Abbott (1958, p. 82), the sculpture and shape of *S. nodulosa* are strongly variable.

Mitra granulosa Lamarck is considered a synonym of *S. nodulosa* by some authors. Pilsbry's (1922, p. 340) record of *S. granulosa* from the Miocene of the Dominican Republic needs confirmation. A single specimen from late Miocene deposits near Puerto Limón, Costa Rica (USGS locality 21056), may be conspecific with *S. nodulosa*, although it has coarser axials than most of the Recent shells.

Occurrence. — USGS 19860.

Distribution. — Pleistocene of Cuba. Recent from Florida and the Bahamas through the West Indies.

Genus **CONOMITRA** Conrad

Conrad, 1865, Amer. Jour. Conchology, vol. 1, pt. 1, p. 25.

Type species (by subsequent designation, Fischer, 1881, Manuel de conchyliologie, p. 613), *Mitra fusoides* Lea.

Conomitra species A

Pl. 55, figs. 19, 20

Of medium size, biconic. Protoconch consists of about two whorls. Postnuclear whorls almost five. Sculpture consists of numerous axials with wider interspaces and low, but broad spirals. There are three to four spirals on the spire whorls. Suture deep. Whorls shouldered near upper suture. Columella with four strong folds. On the lower part of the body whorl there may be secondary spirals.

A single, incomplete specimen from the base of the Melajo Clay is at hand. It is closely related to the Miocene Venezuelan *C. lavelana* F. Hodson (in Hodson and Hodson, 1931a, p. 43, pl. 24, figs. 1-1, 7, 11). The Melajo specimen has a somewhat larger apical angle and finer sculpture. *C. caribbeana* Weisbord (1929, p. 48, pl. 6, figs. 14, 15) from the middle Miocene of Colombia has even coarser axials than *C. lavelana* and is larger.

C. mauryae Rutsch (1942, p. 158, pl. 8, figs. 8a, 8b) from Springvale Quarry is a different species.

Occurrence. — USGS 18411.

Family **TURBINELLIDAE**Genus **TURBINELLA** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 73.

Type species (by monotypy), *Voluta pyrum* Linné.

Turbinella riosecana (H. K. Hodson)

1931. *Xancus praecovoideus riosecanus* H. K. Hodson, in Hodson and Hodson, Bull. Amer. Paleont., vol. 16, No. 60, p. 12, pl. 11, fig. 1, pl. 12, fig. 1.
 1942. *Xancus trinitatis riosecanus* H. K. Hodson, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 161, pl. 9, figs. 1, 3.
 1964. *Turbinella riosecana* (H. K. Hodson), Vokes, Tulane Stud. Geol., vol. 2, No. 2, p. 53. For further citations see this publication

Holotype. — Paleont. Research Inst., Ithaca, N. Y., No. 24148.

Type locality. — About 20 km northeast of Urumaco, Falcón, Venezuela.

A single, incomplete specimen from the base of the Melajo Clay is at hand. It consists of three smooth whorls and has a thick parietal callus. It is about 160 mm high, and its greatest diameter measures 95 mm. The relationships of this species to other forms have been discussed by Vokes (1964, pp. 40, 54).

Occurrence. — USGS 18411.

Distribution. — Savaneta Glauconitic Sandstone Member and

Melajo Clay Member, both of Springvale Fm., Trinidad. Rio Seco Fm. (Pliocene), Falcón, Venezuela.

Family **MARGINELLIDAE**

Genus **PRUNUM** Herrmannsen

Herrmannsen, 1852, *Indicis generum malacozoorum. Supplementa et corrigenda*, p. 113.

Type species (by monotypy), *Voluta prunum* Gmelin.

Subgenus **PRUNUM** s. str.

Prunum (Prunum) dallianum (Maury)

Pl. 57, figs. 1-4

1912. *Marginella dalliana* Maury, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 15, p. 67, pl. 10, figs. 5, 6.

1925. *Marginella dalliana* Maury, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 201.

Of medium size, rather stout. Spire low. Outer lip moderately thickened, smooth. Columella with four folds, the two anterior ones with a narrow interspace and much more oblique than the two posterior ones. Columellar callus inconspicuous. Aperture somewhat broader anteriorly.

Lectotype (herewith selected).—Cornell University, Paleont. Museum, Ithaca, N. Y., unnumbered.

Dimensions of lectotype.—Height 20.3 mm, diameter 13.2 mm.

Type locality.—Point Courbaril area: 1000 feet west of Brighton pier, Trinidad.

Only a few specimens of *P. dallianum* are known from the Courbaril beds. Guppy (*e.g.* 1874, p. 440) cited *P. caeruleascens* Lamarck from the Matura beds several times. *P. caeruleascens* is considered as a synonym of *P. prunum* by some authors. A few specimens from Matura with broken outer lips may represent Guppy's *P. caeruleascens*. Their stoutness, the position of their columellar folds, and the weak callus on the anterior part of the columella suggest that they are conspecific with *P. dallianum*.

The Recent Caribbean *P. prunum* is larger, more slender, and has a high spire. The Recent Eastern Pacific *P. curtum* (G. B. Sowerby I) (Coan and Roth, 1966, p. 280, pl. 48, figs. 4-6) has a somewhat higher spire, weaker columellar folds, and a prominent deposit of callus near the base of the columella which is lacking in *P. dallianum*.

Occurrence.—Point Courbaril: USGS 10991, USGS 20432, USGS 20434, USGS 21778. Matura Bay: JS 67 (?), USGS 19860 (?).

Subgenus **EGOUENA** Jousseaume

Jousseaume, 1875, *Revue et Magasin de Zoologie*, ser. 3, vol. 3, p. 167.

Type species (by subsequent designation, Tomlin, 1917, *Malac. Soc. London, Proc.*, vol. 12, pt. 5, p. 244), *Marginella amygdala* Kiener.

Prunum (Egouena) springvalense (Maury) Pl. 57, figs. 5, 6

1925. *Marginella springvalensis* Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 200, pl. 34, figs. 10, 14.
 1925. *Marginella springvalensis* Maury, Mansfield, U. S. Nat. Mus., *Proc.*, vol. 66, art. 22, p. 38, pl. 6, fig. 13.
 1938. *Marginella (Leptegouana) springvalensis* Maury, Vokes, *Amer. Museum Novitates*, No. 988, p. 4.
 1942. *Marginella (Prunum) springvalensis* Maury, Rutsch, *Verh. Naturf. Ges. Basel*, vol. 54, p. 104.

Of medium to large size, solid. Spire moderately elevated. Outer lip strongly thickened. Parietal callus not prominent. The four columellar folds of about the same strength, the two anterior ones more closely set and more oblique than the others. Aperture wider anteriorly. Callus of outer lip not reaching beyond penultimate whorl posteriorly.

Lectotype (herewith selected). — *Paleont. Research Inst.*, Ithaca, N. Y., No. 1038 (specimen figured by Maury, 1925, pl. 34, fig. 14).

Dimensions of lectotype. — Height 41.4 mm, greatest diameter 25.5 mm.

Type locality. — Springvale Quarry, Trinidad.

P. springvalense occurs abundantly in the Savaneta Glauconitic Sandstone Member, but at the base of the Melajo Clay only a few specimens have been found.

P. springvalense is related to the Miocene Venezuelan *P. democracianum* (F. Hodson) (in Hodson, Hodson and Harris, 1927, p. 76, pl. 40, fig. 20). *P. democracianum* has a higher spire and a more inflated body whorl. *P. springvalense* does not have a close Recent relative in the Western Atlantic or the Eastern Pacific.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Prunum (Egouena) calypsonis (Maury) Pl. 57, figs. 9, 10

- ?1910. *Marginela* (sic) *coniformis* G. B. Sowerby I, Guppy, *Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440*, p. 8; reprint, Harris, 1921, *Bull. Amer. Paleont.*, vol. 8, No. 35, p. 151.

1925. *Marginella calypsonis* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 199, pl. 34, figs. 12, 13.
1925. *Marginella calypsonis* Maury, Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 39, pl. 6, fig. 11.
1938. *Marginella (Egouana) calypsonis* Maury, Vokes, Amer. Museum Novitates, No. 988, p. 4.
1942. *Marginella (Prunum) calypsonis* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 104.

Of medium size, solid. Spire moderately elevated. Outer lip strongly thickened. Callus of inner lip thick, reaching from the base of the columella to the top of the spire. Spire whorls recognizable on dorsal side only. Columellar folds four, the two anterior ones more oblique and somewhat stronger.

Lectotype (herewith selected). — Paleont. Research Inst., Ithaca, N. Y., No. 1037 (specimen figured by Maury, 1925, pl. 34, fig. 13).

Dimensions of lectotype. — Height 21.6 mm, greatest diameter 12.1 mm.

Type locality. — Springvale Quarry, Trinidad.

Like *P. springvalense* this species is abundant in the Savaneta Glauconitic Sandstone Member, but only a few specimens have been collected at the base of the Melajo Clay.

The Venezuelan Miocene *P. berjadinense* (F. Hodson) (in Hodson, Hodson and Harris, 1927, p. 75, pl. 37, figs. 11, 13, pl. 40, figs. 16, 18) seems to be related to *P. calypsonis*, although it is smaller and its parietal callus less prominent. The figured paratype of *P. suteri* (Rutsch) (1934, pl. 8, figs. 8, 9; not figs. 6, 7, 10), from the late Miocene Punta Gavilán Formation of Venezuela, has about the dimensions of *P. calypsonis*. Its parietal callus is not so thick as in *P. calypsonis* (in this respect more resembling *P. berjadinense*) and its outer lip less thickened.

The Recent Western Atlantic *P. cinctum* (Kiener) (Spéciés général, *Marginella*, p. 21, pl. 8, fig. 32) probably is a descendant of *P. calypsonis*. Its parietal callus and outer lip are even heavier.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Genus **VOLVARINA** Hinds

Hinds, 1844, Zool. Soc. London, Proc., pt. 12, p. 75.

Type species (by subsequent designation, Redfield, 1870, Amer.

Jour. Conch., vol. 6, pt. 2, p. 221), *Marginella nitida* Hinds (= *Voluta mitrella* Risso).

Volvarina (?) species A

Pl. 57, fig. 17

Shell large, solid. Spire low, but pointed. Outer lip thickened, straight. Columella with four folds of about equal strength. Aperture wider anteriorly. Columellar callus inconspicuous.

A few specimens of this form occur at the base of the Melajo Clay and probably represent a new species. They are somewhat larger, stouter, and have a lower spire than the middle Miocene *Marginella leander* Brown and Pilsbry (1911, p. 347, pl. 24, fig. 13; Olsson, 1922, p. 98, pl. 6, fig. 22) from Panama. *Marginella collina* Olsson (1922, p. 97, pl. 7, figs. 26, 27) from the middle Miocene of Costa Rica is smaller and more slender.

Occurrence. — USGS 18411, USGS 18634.

Volvarina (?) species B

Pl. 57, fig. 16

A few specimens from the Courbaril beds and Matura are similar to *Volvarina* (?) species A. Their outer lip, however, is not straight, and there is a shallow concavity near the base of the columella which is not present in the Melajo specimens.

There seems to be no closely related Recent Caribbean species. *V. avena* (Kiener) (Abbott, 1958, p. 85, pl. 21) is much more slender, and the central part of its outer lip is slightly constricted.

Occurrence. — Point Courbaril: USGS 20432. Matura Bay: JS 67, RR 230, PJ 302, USGS 19860.

Genus PERSICULA Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, p. 235.

Type species (by monotypy), *Persicula variabilis* Schumacher (= *Voluta persicula* Linné).

Subgenus RABICEA Gray

Gray, 1857, Guide to the systematic distribution of Mollusca in the British Museum, p. 37.

Type species (by monotypy), *Marginella interrupta* Lamarck (= *Voluta interruptolineata* Megerle von Mühlfeld).

Persicula (Rabicea) couviana (Maury)

Pl. 57, figs. 13-15

1925. *Marginella* (*Persicula*) *couviana* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 202, pl. 34, fig. 11.

1925. *Marginella (Persicula) propeobesa* Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 41, pl. 6, fig. 10.
 1938. *Marginella (Persicula) couviana* Maury, Vokes, Amer. Museum Novitates, No. 988, p. 4.
 1938. *Marginella (Persicula) propeobesa* Mansfield, Vokes, *ibidem*, p. 4.
 1942. *Persicula (Rabicea) couviana* (Maury), Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 165.

Of medium size, solid. Outer lip thickened, denticulated within. Parietal callus thin, with an inconspicuous axial ridge. Columella with two prominent folds at base, the upper one being stronger. Above them there is a variable number of shorter and weaker ridges. Basal notch deep.

Holotypes.—Of *P. couviana*: Paleont. Research Inst., Ithaca, N. Y., No. 1035. Of *P. propeobesa*: USNM 352651.

Type locality.—For both species: Springvale Quarry, Trinidad.

P. couviana occurs at the base of the Melajo Clay. Most specimens are perfectly preserved. Some of the Melajo shells reach a larger size than topotypes. The prominence of the denticles on the inner surface of the outer lip is variable. The denticles may be lacking in immature shells but are present in adults.

P. couviana is closely related to the Miocene Venezuelan *P. venezuelana lavelana* (F. Hodson) (in Hodson, Hodson and Harris, 1927, p. 78, pl. 40, figs. 3, 10, 11). In fact the differences are slight. The Venezuelan species tends to be stouter and has a thicker parietal callus.

Occurrence.—USGS 18411, USGS 18634.

Distribution.—Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Persicula (Rabicea)* cf. *interruptolineata (Megerle von Mühlfeld)

Pl. 57, figs. 11, 12

A number of specimens from Matura may be referable to the Recent Caribbean *P. interruptolineata*. No color patterns are preserved. They show a considerable variation as to stoutness. The denticulation on the inner surface of the outer lip is weak, if present. The groove above the two basal columellar folds is sometimes not pronounced at all.

A similar variability is shown by Recent specimens. According to Coan and Roth (1966, p. 284) *P. interrupta marcana* Weisbord (1962, p. 409, pl. 37, figs. 9-14) and *P. hodsoni* Weisbord (1962, p.

412, pl. 38, figs. 5-8), both from the Pliocene of Venezuela, probably represent *P. interruptolineata*.

Occurrence. — K 10924, JS 67, RR 230, USGS 18204, USGS 19860.

Genus **BULLATA** Jousseau

Jousseau, 1875, *Revue et Magasin de Zoologie*, ser. 3, vol. 3, pp. 167, 250

Type species (by tautonymy), *Voluta bullata* Born.

Bullata maiae (Maury)

Pl. 57, figs. 7, 8

1925. *Marginella (Volutella) maiae* Maury, *Bull. Amer. Paleont.*, vol. 10, No. 42, p. 201, pl. 34, fig. 9.

1938. *Marginella (Volutella) maiae* Maury, Vokes, *Amer. Museum Novitates*, No. 988, p. 4.

1942. *Marginella (Bullata) bullata maiae* Maury, Rutsch, *Verh. Naturf. Ges. Basel*, vol. 54, p. 165.

Holotype. — Paleont. Research Inst., Ithaca, N. Y., No. 1033.

Type locality. — Springvale Quarry, Trinidad.

B. maiae occurs in the Melajo Clay in fragments only. One fragment representing part of a body whorl reaches a height of 66 mm. A complete, but somewhat deformed specimen from the Savaneta Glauconitic Sandstone Member, is figured. Its spire is flat and submerged, and the outer lip reaches higher up.

The Recent *B. bullata* from Brasil is more inflated. Its outer lip bears denticles, whereas that of *B. maiae* is smooth. The outer lip of *B. maiae* is more thickened, and the base of the aperture much wider than in *B. bullata*.

B. popenoi (Mansfield) (1930, p. 54, pl. 4, figs. 9, 11) from the late Miocene of Florida is smaller, has a denticulated outer lip, and a narrower aperture.

Occurrence. — Hutch 47, Hutch 51, PJ 285, USGS 21178.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Bullata maturensis, n. sp.

Pl. 58, figs. 1, 2

Shell large, slender. Spire flat, forming a horizontal plane with the uppermost part of the outer lip. Body whorl only slightly inflated. Aperture wider anteriorly. Outer lip thick, smooth, almost straight. Columellar folds four, the two anterior ones more oblique.

Holotype. — Natural History Museum Basel, No. H 15270.

Dimensions of holotype. — Height 40.0 mm, greatest diameter 19.5 mm.

Type locality. — Matura Bay: RR 230.

B. maturensis is represented from Matura by one adult shell, the holotype, and two immature specimens. Three immature shells from the Courbaril beds are identified as this species as well.

B. maturensis is characterised by its slender shape and its straight outer lip. None of the large species of *Bullata* show these features. The wide anterior part of the aperture is similar to that of *B. maiae*, but *B. maiae* is larger and more inflated. The Recent *B. bullata* is even more inflated, and the shape of the aperture entirely different.

Large species of *Bullata* occur in the Caribbean region from Miocene to Recent. No Recent analogue is known from the Eastern Pacific.

Occurrence. — Point Courbaril: K 12255, USGS 20434, USGS 21778. Matura Bay: RR 230.

Family **CANCELLARIIDAE**

Genus **CANCELLARIA** Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 71.

Type species (by monotypy), *Voluta reticulata* Linné.

Subgenus **EUCLIA** H. and A. Adams

H. and A. Adams, 1854, The Genera of Recent Mollusca, vol. 1, p. 277.

Type species (by subsequent designation, Cossmann, 1899, Essais de paléoconchologie comparée, pt. 3, p. 10), *Cancellaria cassidiformis* G. B. Sowerby I.

Cancellaria (Euclia) montserratensis Maury Pl. 58, figs. 6, 7

1925. *Cancellaria montserratensis* Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 194, pl. 35, figs. 6, 8.

1925. *Cancellaria springvaleensis* Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 31, pl. 2, fig. 12.

1938. *Cancellaria (Cancellaria) couvana* Vokes, Amer. Museum Novitates, No. 988, p. 20, fig. 21.

1942. *Cancellaria montserratensis* Maury, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 163, pl. 9, figs. 7a, 7b.

Of medium size. Protoconch with $2\frac{1}{2}$ whorls. Postnuclear whorls five. Early sculpture consisting of four to five spirals and about 10 axials. Subsequently the whorls become strongly

shouldered. One spiral is sitting on the shoulder, two broad spirals are below the shoulder and a third one at the lower suture. Between shoulder and upper suture there are two or three minor spirals. Shoulder with nodes where crossed by axials. Parietal callus large and prominent. Columella with three folds, the lowest one inconspicuous. Between the upper two folds there are three small pustules near the margin of the callus. Outer lip lirate within. Umbilical opening small. Siphonal fasciole prominent, sculptured by several spirals.

Types.—Lectotype of *C. montserratensis* (herewith selected): Paleont. Research Inst., Ithaca, N. Y., No. 1046 (specimen figured by Maury, 1925, pl. 35, fig. 8). Holotype of *C. springvaleensis*: USNM 352662. Holotype of *C. couvana*: Amer. Museum Nat. Hist., No. 24667.

Dimensions of lectotype of montserratensis.—Height 27.6 mm, greatest diameter 15.8 mm.

Type locality (of all three species).—Springvale Quarry, Trinidad.

This species is represented by two shells from the base of the Melajo Clay. Both of them have a strongly angulated shoulder. As pointed out by Rutch (1942, p. 164) the degree of this angulation is variable.

There are many species of *Euclia* in deposits of the late Tertiary Caribbean faunal province. The subgenus is now living in the Eastern Pacific but not in Caribbean waters. Many of these species have more or less shouldered whorls and more or less persistent axial and spiral sculpture. One of the strongly shouldered species is *C. triangularis* Nelson (1870, p. 191, pl. 6, fig. 10; Olsson, 1932, p. 158, pl. 18, figs. 1, 2) from the middle Miocene of Peru. It has stronger spirals, more axials, and the lower part of its body whorl is more constricted than in *C. montserratensis*.

The type species of *Euclia*, the Recent Eastern Pacific *C. cassidiformis* G. B. Sowerby I (in Broderip and Sowerby, 1832-1833, p. 53, 1832) is much larger, less strongly shouldered, and spiny at the shoulder.

Occurrence.—USGS 18634.

Distribution.—Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Cancellaria (Euclia) cf. codazzii Anderson

Pl. 58, fig. 8

Of medium size. Spire high. Protoconch with $21\frac{1}{2}$ smooth whorls. Postnuclear whorls $5\frac{1}{2}$. Sculpture starting with axials. Early whorls strongly shouldered, with nine axials per whorl and three spirals. Subsequently the whorls are less shouldered and the number of axials increases rapidly. There are about 21 axials on the body whorl. Late spire whorls with a spiral on the weakly accentuated shoulder, two spirals below the shoulder, and one or two weak spirals near the upper suture. On the penultimate and the body whorls a fine spiral thread appears above the shoulder. There are about 18 spirals below the shoulder of the body whorl, some of which are of secondary size. Outer lip lirate within. Columellar folds three, the lowest one weak. Parietal callus thin. Umbilical opening small. Siphonal fasciole not prominent.

A single, damaged shell from the Melajo Clay is available. It may be conspecific with *C. codazzii* Anderson (1929, p. 116, pl. 14, figs. 4-7; Barrios, 1960, p. 291, pl. 11, fig. 5) from the middle Miocene of Colombia, but more specimens are needed to be certain. *C. acuticarinata* Weisbord (1929, p. 51, pl. 6, fig. 7), also from the Miocene of Colombia, seems to be related to *C. codazzii*.

The Melajo specimen is more slender and has more axials than the Recent *C. balboae* Pilsbry (1931, p. 439, pl. 41, figs. 7, 8) from Panama Bay.

Occurrence. — USGS 21178.

Subgenus **NARONA** H. and A. Adams

H. and A. Adams, 1854, The Genera of Recent Mollusca, vol. 1, p. 277.

Type species (by subsequent designation, Cossmann, 1899, *Essais de paléoconchologie comparée*, pt. 3, p. 5), *Cancellaria clavatulula* G. B. Sowerby I.

Cancellaria (Narona) semota, n. sp.

Pl. 58, figs. 4, 5

Of medium size, slender. Protoconch with $23\frac{3}{4}$ smooth whorls, its axis slightly oblique to main shell axis. The first $13\frac{1}{4}$ whorls of the protoconch are flat-sided, the remainder inflated. Postnuclear whorls almost six. Sculpture starts abruptly, consists of eight axials per whorl and two spirals which give a bicarinate appearance. Subsequently additional spirals are intercalated and the axials become swollen. There are six spirals on the penultimate whorl. Axials on

body whorl of unequal size. Outer lip thickened, denticulated within. Parietal callus not well developed. Columella with two strong folds. Umbilical opening small. Siphonal fasciole moderately prominent. Canal long.

Holotype. — USNM 645498.

Dimensions of holotype. — Height 17.7 mm, greatest diameter 8.0 mm.

Type locality. — Melajo River area: USGS 21178.

This species is based on the holotype only which has been collected from the Melajo Clay. The anterior extremity of the shell is not complete.

C. bullbrookii Mansfield (1925, p. 31, pl. 5, fig. 3) from the Miocene of Trinidad is based on the holotype (USNM 352663) only which is probably immature. The axis of the protoconch of *C. bullbrookii* is even more oblique than that of *C. semota*. The early sculpture of both species is the same, but additional spirals appear later in *C. semota*. The nuclear and sculptured whorls are stouter and more inflated in *C. bullbrookii*. *C. semota* is more slender than *C. decaptyx* Brown and Pilsbry (1911, p. 346, pl. 24, figs. 5, 6) from the middle Miocene of the Panama Canal Zone, and has less axials on late whorls. *C. tremula* Olsson (1932, p. 162, pl. 15, figs. 11, 12) from the upper Miocene of Peru has a larger apical angle, less incised sutures, and more axials on the body whorl.

The nuclear whorls of the Recent Eastern Pacific *C. clavatula* G. B. Sowerby I (*in* Broderip and Sowerby, 1832-1833, p. 52, 1832), the type species of *Narona*, are more inflated, and secondary spirals appear earlier than in *C. semota*. The Melajo species is more slender than *C. clavatula*.

Occurrence. — USGS 21178.

Subgenus **CHARCOLLERIA** Olsson

Olsson, 1942, Bull. Amer. Paleont., vol. 27, No. 106, p. 61.

Type species (by original designation), *Cancellaria (Charcolleria) perdiciana* Olsson.

Cancellaria (Charcolleria) species

Pl. 58, fig. 3

A single, somewhat worn specimen from the base of the Melajo Clay is available. It consists of a little less than six whorls including protoconch. The sculpture is predominantly spiral, the interspaces

of the spirals narrow. Whorls moderately convex. Sutures not deeply incised. Inner surface of outer lip with lirations. Columellar callus prominent. Columella with two strong folds. Anterior canal long.

Although much smaller, the Melajo shell seems to be more closely related to *C. perdiciana* Olsson (1942, p. 61, pl. 8, fig. 5) from the lower Miocene of Colombia than to the Pliocene *C. terryi* Olsson (1942, p. 62, pl. 8, fig. 1) from Panama. *C. terryi* is more slender, has more inflated whorls with deeply incised sutures and heavier sculpture.

Occurrence. — USGS 18634.

Genus **TRIGONOSTOMA** Blainville

Blainville, 1827, Manuel de malacologie et de conchyliologie, p. 652.

Type species (by monotypy and tautonymy), *Delphinula trigonostoma* Lamarck.

Subgenus **EMMONSELLA** Olsson and Petit

Olsson and Petit, 1964, Bull. Amer. Paleont., vol. 47, No. 217, p. 541.

Type species (by original designation), *Cancellaria tenera* Philippi.

Trigonostoma (Emmonsella) species

A single, incomplete shell from the base of the Melajo Clay is available. Protoconch with two whorls. Early sculpture consists of a few spirals with narrow interspaces. On later whorls one of the central spirals becomes more prominent than the others. Axial sculpture inconspicuous.

The Melajo shell is too incomplete to point out affinities. Although not recorded, a species of *Trigonostoma* occurs in the Savaneta Glauconitic Sandstone Member as well. The few specimens known are incomplete and deformed. They do not seem to be conspecific with the Melajo shell.

Occurrence. — USGS 18634.

Family **CONIDAE**

Genus **CONUS** Linné

Linné, 1758, Systema Naturae, ed. 10, p. 712.

Type species (by subsequent designation, Children, 1823), *Conus marmoreus* Linné. See Kennard, Salisbury and Woodward (1931, p. 35).

Conus springvaleensis Mansfield

Pl. 58, fig. 9

1867. *Conus planiliratus* G. B. Sowerby I, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 159; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 38.
1874. *Conus planiliratus* G. B. Sowerby I, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 440 (part).
1910. *Conus planiliratus* G. B. Sowerby I, Guppy, Agric. Soc. Trinidad and Tobago, Soc. Paper No. 440, p. 6; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 149.
1925. *Conus planiliratus* G. B. Sowerby I, Maury, Bull. Amer. Paleont., vol. 10, No. 42, p. 186, pl. 34, fig. 6.
- ?1925. *Conus burckhardti* Böse, Maury, *ibidem*, p. 187, pl. 34, fig. 5.
1925. *Conus springvaleensis* Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 11, pl. 1, figs. 3, 6.
1938. *Conus (Leptoconus) springvaleensis* Mansfield, Vokes, Amer. Museum Novitates, No. 988, p. 3.
1942. *Conus springvaleensis* Mansfield, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 104.

Of small to medium size, moderately slender. Spire somewhat concave in profile. Protoconch high, slender, consists of more than three smooth whorls. Postnuclear whorls nine. Early spire whorls strongly angulated on lower part, without tubercles. Sculpture consists of opisthocyrt growth lines only. Late spire whorls with a few scarcely visible spirals. Shoulder of body whorl strongly angulated. Sculpture of body whorl consists of a variable number of widely spaced spiral grooves which cover most of the body whorl. Anal notch moderately deep. Aperture slightly wider anteriorly.

Holotype. — USNM 352644.

Type locality. — Springvale Quarry, Trinidad.

This species is represented by a few specimens from the base of the Melajo clay. The sculpture of the last whorl of immature specimens is usually restricted to the lower half of the whorl.

C. springvaleensis is related to the widespread *C. imitator* Brown and Pilsbry (1911, p. 342, pl. 23, fig. 4), which has originally been described from the middle Miocene of the Panama Canal Zone. *C. imitator* is larger and has a less concave spire. The same is true for *C. imitator lius* Woodring (1928, p. 209, pl. 10, figs. 5, 6) from the Bowden Formation of Jamaica. In addition *C. imitator* has tubercles on early spire whorls and a smaller protoconch. *C. sophus* Olsson (1932, p. 151, pl. 16, figs. 6, 8, 9) from the Miocene of Peru has a similar protoconch, but it is a smaller species, and the anterior part of its body whorl is somewhat constricted.

The Recent Eastern Pacific *C. arcuatus* Broderip and G. B.

Sowerby I (Hanna and Strong, 1949, p. 292, pl. 5, figs. 2-4) essentially has a higher spire. Its Pliocene subspecies *C. vacuanus* Olsson (1942, p. 49, pl. 6, figs. 11, 12) from Costa Rica and Panama has a less concave spire.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Conus couvaensis Vokes

Pl. 58, figs. 10, 11

1938. *Conus (Lithoconus) couvaensis* Vokes, Amer. Museum Novitates, No. 988, p. 18, fig. 16.

1942. *Conus couvaensis* Vokes, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 104.

Of medium size, stout. Spire low. Protoconch not preserved. Postnuclear whorls eight. Spire whorls concave above shoulder, sculptured by opisthocyrt growth lines only. Anal notch deep. Body whorl somewhat convex below shoulder, sculptured by a few spirals near the base.

Holotype. — Amer. Museum Nat. Hist., No. 24998.

Type locality. — Springvale Quarry, Trinidad.

C. couvaensis occurs at the base of the Melajo Clay. The stout shape and low spire suggest a relationship to the middle Miocene *C. aemulator* Brown and Pilsbry (1911, p. 342, pl. 23, fig. 9) from the Panama Canal Zone and *C. veatchi* Olsson (1922, p. 44, pl. 2, figs. 5, 8) from Water Cay, Panama, and the Panama Canal Zone, which are considered as synonyms by some authors. *C. couvaensis*, however, lacks the spirals above the shoulder and is smaller. Rutsch (1934, p. 104, pl. 9, figs. 7-11) recorded *C. aemulator* from the late Miocene Punta Gavilán Formation of Venezuela and treated it as a subspecies of the Recent Caribbean *C. proteus* Hwass.

The holotype of *C. manzanillaensis* Mansfield (1925, p. 12, pl. 2, figs. 5, 10) from the middle Miocene Manzanilla Formation of Trinidad is imperfect and the only specimen known. Its early spire whorls are tuberculated. The spire whorls are less concave than in *C. couvaensis*, and there are traces of spirals.

Occurrence. — USGS 18411, USGS 18634.

Distribution. — Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Conus species

A small species of *Conus* occurs in the Matura shell bed. Only

two specimens are available. The larger one is 20.3 mm high and worn. The other shell is unworn and shows that the early spire whorls are tuberculated, and that there are a few fine spirals above the shoulder. These spirals disappear on later spire whorls. Spire moderately high, slightly concave. Shoulder of body whorl strongly angulated. Body whorl smooth except for spirals near the base.

Guppy cited *Conus pusio* Bruguière from Matura. According to Clench (1942a, p. 10) *Conus pusio* Hwass is the same as *C. jaspideus* Gmelin. The body whorl of *C. jaspideus* is usually covered by widely spaced spirals, whereas on the Matura specimens the spirals are restricted to the lowest part of the body whorl.

Occurrence. — RR 230, USGS 19860.

Family TURRIDAE

Genus POLYSTIRA Woodring

Woodring, 1928, Carnegie Inst. Washington, Pub. 385, p. 145.

Type species (by original designation), *Pleurotoma albida* Perry.

Polystira species A

The Matura shell bed has yielded a few small fragments of a *Polystira*. They are too worn to point out affinities. The strongest spiral is situated a little above the middle of the whorl. Below it there are two fine spirals, above it one stronger one.

Occurrence. — JS 67, RR 230, PJ 302, USGS 19860.

Polystira species B

Pl. 59, fig. 13

A few immature specimens from the Melajo Clay are available. The figured specimen is perfectly preserved. The protoconch consists of $1\frac{1}{2}$ whorls, and its last part is sculptured by a few fine axials. There are six postnuclear whorls preserved. First sculpture consists of opisthocyt axials, a sharp subsutural spiral, and a stronger spiral at about the middle of the whorl. On subsequent whorls the spirals become stronger and the growth lines prominent. On the fourth sculptured whorl a secondary spiral and a little later a second one appear below the medial keel. Anterior canal slightly twisted to the left.

The early sculpture of the Recent Western Atlantic *P. florencae* Bartsch (1934, p. 9, pl. 3, figs. 4-7) is similar to the Melajo species,

but the protoconch of *P. florencae* is larger, and the axials on the first sculptured whorl less prominent. *P. florencae* has a longer anterior canal.

The relations to *Polystira* species A from Matura are uncertain until better specimens are available, although both have a similar early sculpture.

Occurrence. — EL 1810, PJ 285, USGS 18399.

Genus **CARINODRILLIA** Dall

Dall, 1919, U. S. Nat. Mus., Proc., vol. 56, No. 2288, p. 17.

Type species (by original designation), *Clathrodrillia* (*Carinodrillia*) *halis* Dall.

Carinodrillia meraca, n. sp.

Pl. 58, figs. 15, 16

Of small to medium size, slender. Protoconch with three smooth whorls. Postnuclear whorls nine. First sculpture consists of opisthocline axials which gradually become stronger. After a little more than half a whorl a subsutural spiral appears. At the same time or a little later two spirals appear on the lower part of the whorl. They are more prominent, where they cross the axials. Late spire whorls with one or two additional spirals near the lower suture. There are seven axials on late whorls. Anal fasciole sculptured by three or four spiral threads and conspicuous growth lines. Body whorl with about 11 spirals and about four minute spiral threads in their interspaces. Anal sinus deep. Outer lip thickened. Columellar callus prominent, smooth. Anterior canal moderately long. Siphonal fasciole slightly bulging, sculptured by a few spirals.

Holotype. — USNM 645499.

Dimensions of holotype. — Height 17.8 mm, greatest diameter 5.0 mm.

Type locality. — Melajo River area: USGS 21178.

This species occurs in the Melajo Clay and is represented by about 30 specimens. Many of them are immature or incomplete. The outer lip of the holotype is broken.

C. meraca is an extremely slender species. It is closely related to the Miocene *C. aquanica* Olsson (1922, p. 65, pl. 5, figs. 16, 17) from Costa Rica. *C. aquanica* has more and more prominent axials and is somewhat less slender.

C. propefusiformis (Mansfield) (1925, p. 20, pl. 2, figs. 3, 4)

from the middle Miocene of Trinidad is considerably larger. It is less slender and has less, but much broader axials. Rutsch (1942, p. 168) reported two specimens from the Savaneta Glauconitic Sandstone Member of the Springvale Formation as *Carinodrillia* ? sp. ind. Although similar in sculpture, they differ in being less slender than *C. meraca*.

Occurrence. — EL 1810, K 9903, PJ 285, USGS 18399, USGS 21178.

Genus **CRASSISPIRA** Swainson

Swainson, 1840, Treatise on Malacology, p. 313.

Type species (by subsequent designation, Herrmannsen, 1847, *Indicis generum malacozoorum primordia*, vol. 1, p. 318), *Pleurotoma bottae* Kiener.

Subgenus **CRASSISPIRA** s. str.

Crassispira (Crassispira) cf. caroniana (Maury) Pl. 59, fig. 4

A single specimen from the Melajo Clay is available. Its tip and the outer lip are broken. There are 12 opisthocline, narrow axials on late whorls. Late spire whorls with four fine spirals. Opisthocyrt growth lines on anal fasciole prominent. Subsutural spiral sharp. Anterior canal long.

The axials of topotypes of *C. caroniana* (Maury) (1925, p. 189, pl. 32, fig. 12) from the Savaneta Glauconitic Sandstone Member are somewhat more rounded than those of the Melajo shell. The Melajo specimen has less spirals on the spire whorls.

C. henekeni (G. B. Sowerby II) (1850, p. 50, pl. 10, fig. 6) from the Miocene of the Dominican Republic is a different species. It has less, but broader axials, which are almost orthocline.

Occurrence. — PJ 285.

Crassispira (Crassispira) faceta, n. sp. Pl. 59, figs. 5, 6

Shell large, moderately slender. Protoconch with almost three whorls. Postnuclear whorls $8\frac{1}{2}$. Sculpture consists of a sharp subsutural spiral and slightly opisthocline axials. There are 13 axials on the penultimate whorl; their crests somewhat sharpened. Anal fasciole concave, sculptured by opisthocyrt growth lines. Spire whorls with six or seven spirals below anal fasciole. Aperture long. Anterior canal moderately long. Siphonal fasciole slightly bulging.

Holotype. — Natural History Museum Basel, No. H 15317.

Dimensions of holotype. — Height 39.5 mm, greatest diameter 12.2 mm.

Type locality. — Matura Bay: RR 230.

This species is represented from Matura by the holotype and two immature, fragmentary specimens. The outer lip of the holotype is broken.

C. faceta is closely related to *C. caroniana* (Maury) (1925, p. 189, pl. 32, fig. 12). It differs in being less slender and in having lower, stouter whorls. It is also less slender than *C. aegis* Woodring (1928, p. 151, pl. 4, fig. 12) from the Bowden Formation of Jamaica. *C. aegis* has proportionately higher whorls, its axials are almost orthocline, and its protoconch has less whorls.

Occurrence. — RR 230, USGS 18204.

Subgenus **CRASSISPIRELLA** Bartsch and Rehder

Bartsch and Rehder, 1939, U. S. Nat. Mus., Proc., vol. 87, No. 3070, p. 135.

Type species (by original designation), *Turris* (*Crassispira*) *rugitecta* Dall.

Crassispira (Crassispirella) ritanida (Mansfield) Pl. 59, figs. 11, 12

1867. *Pleurotoma luctuosa* d'Orbigny, Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, p. 159 (part); reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, p. 38.

1874. *Pleurotoma luctuosa* d'Orbigny, Guppy, Geol. Mag., new ser., decade 2, vol. 1, p. 440 (part).

1925. *Drillia ritanida* Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 24, pl. 4, fig. 10.

Of small size. Protoconch consists of $1\frac{1}{2}$ smooth whorls. Post-nuclear whorls six. First sculpture consists of closely spaced axials with a few minute spirals in their interspaces. After about a quarter of a whorl the subsutural spiral appears which gradually becomes stronger. Axials on early sculptured whorls reach from subsutural cord to lower suture, but gradually disappear on anal fasciole. There are about 12 axials on the body whorl. Late spire whorls with five or six spirals between the axials and about four finer spirals on the anal fasciole. Body whorl with about 11 primary spirals below the anal fasciole and one or two secondary spirals in each interspace. Outer lip smooth within. Anal sinus moderately deep. Parietal callus smooth. Pillar sculptured by a few spirals.

Holotype. — USNM 115581.

Type locality.—Matura, Trinidad.

C. ritanida was originally based on the holotype only. Later collections from Matura have yielded 18 additional specimens, most of which, however, are incomplete.

C. ebenina (Dall) [1890-1903 (1890), p. 33, pl. 2, fig. 8], which is said to range from Miocene to Recent, essentially is a larger and stouter species with a sharper subsutural cord. According to Abbott (1958, p. 94) *C. ebenina* is a synonym of *C. fuscescens* (Reeve). *C. oerteli* (Böse) (in Böse and Toulou, 1910, p. 249, pl. 13, fig. 24) from the upper Miocene of the Tehuantepec area, Mexico, has similar dimensions and proportions, but it has more axials which are crossed by the spirals.

Occurrence.—RR 230, PJ 302, USGS 18204, USGS 19860.

Distribution.—Known from type locality only.

Genus **AGLADRILLIA** Woodring

Woodring, 1928, Carnegie Inst. Washington Pub. 385, p. 157.

Type species (by original designation), *Agladrillia callothyra* Woodring.

Agladrillia (?) **lassula**, n. sp.

Pl. 59, figs. 1-3

Of medium size, stout. Protoconch with $1\frac{3}{4}$ whorls, its last part with an anterior angulation. Postnuclear whorls nine. Early sculpture consists of opisthocline axials which are considerably broader near the lower suture. Axials of later whorls opisthocline below anal fasciole, weaker and opisthocyrt on anal fasciole. Spiral sculpture consists of narrow grooves; those below the anal fasciole more widely spaced. At some distance from the outer lip there is an inconspicuous hump, after which the axials (but not the spiral grooves) are practically suppressed. Anal sinus deep. Stromboid notch conspicuous. Anterior canal short, slightly widening near base. Parietal callus greatly thickened near anal sinus. Columellar callus somewhat detached from pillar.

Holotype.—Natural History Museum Basel, No. H 15311.

Dimensions of holotype.—Height 16.4 mm, greatest diameter 6.5 mm.

Type locality.—Melajo River area: Hutch 47.

This species occurs in the Melajo Clay and is represented by 20 incomplete specimens. It is assigned to the genus *Agladrillia*

with hesitation only. The type species of the genus, *A. callothyra* Woodring (1928, p. 158, pl. 5, fig. 7), from the Bowden Formation of Jamaica, has stronger sculpture, more inflated whorls, and a subsutural spiral which is not developed in the Melajo species. However, there are species without subsutural spiral which have been assigned to *Agladrillia* such as *A. aulakoessa* Gardner [1926-1950 (1937), p. 310, pl. 40, figs. 2-4] from the Chipola Formation of Florida.

A. musacina (Olsson) (1922, p. 69, pl. 5, figs. 27, 28), from the middle Miocene of Costa Rica, is a smaller and more slender form. According to topotypes its protoconch is indistinguishable from that of *A. (?) lassula*, and there is no subsutural spiral as well.

Occurrence.—Hutch 47, Hutch 51, EL 1810, KR 11862, PJ 285, USGS 21178.

Genus **LEPICYTHARA** Olsson

Olsson, 1964, Neogene Mollusks from Northwestern Ecuador, p. 110, Palcont. Research Inst.

Type species (by original designation), *Cythara terminula* Dall.

Lepicythara disclusa, n. sp.

Pl. 59, figs. 7-10

1942. "*Cythara*" (*Brachycythara* ?) cf. *terminula* Dall, Rutsch, Verh. Naturf. Ges. Basel, vol. 54, p. 169, pl. 3, figs. 10, 11.

Of medium size, biconic. Protoconch consists of two smooth whorls. Postnuclear whorls $6\frac{1}{2}$. First sculptured whorl with numerous opisthocline axials. The second sculptured whorl is strongly inflated, or almost angulated at the middle of its height. It bears fewer, but much stronger axials, and a few spirals on its lower part. Subsequently the angulation of the whorl approaches the lower suture until it disappears. Late spire whorls with eight to ten, but usually nine broad, somewhat curved axials, which are crossed by numerous flat spirals with narrower interspaces. Spirals usually arranged in pairs. Inner lip smooth. Margin of outer lip weakly crenulated by external spiral sculpture. Inner surface of outer lip with a more or less pronounced axial ridge. Anterior canal moderately long. Anal sinus shallow.

Holotype.—Natural History Museum Basel, No. H 15291.

Dimensions of holotype.—Height 16.0 mm, greatest diameter 7.1 mm.

Type locality.—Melajo River area: PJ 285.

This species is represented from the Melajo Clay by about 40 specimens. Of these only few were collected from the base of the Melajo Clay. The axials are usually aligned on successive late whorls but never so on early postnuclear whorls. The specimens from the Savaneta Glauconitic Sandstone Member figured by Rutsch are not adult and have a stouter appearance.

Cythara sp. ind. as mentioned by Mansfield (1925, p. 26) from the Brasso Formation of Trinidad is a species of *Lepicythara*, but the specimen is immature and too incomplete for specific identification.

The type species of *Lepicythara*, *L. terminula* (Dall) [1890-1903 (1890), p. 38, pl. 2, fig. 5] from the Pliocene of Florida, essentially is a more slender species, *i.e.* it has a smaller apical angle. It has narrower axials, its spiral sculpture is less prominent, and its aperture is somewhat narrower. *L. turrita* (Mansfield) (1930, p. 43, pl. 3, fig. 8) from the upper Miocene of Florida is smaller and has less axials. Its spiral sculpture is even flatter than in *L. disclusa*, but its axials are heavier and more bulging.

L. costaricensis (Olsson) (1922, p. 77, pl. 5, figs. 21, 22) from the middle Miocene of Costa Rica is smaller, more slender, and its axials are narrower. *L. heptagona* (Gabb) (1873b, p. 211; Pilsbry, 1922, p. 322, pl. 17, fig. 9) and *L. cercadica* (Maury) (1917, p. 61, pl. 9, fig. 15), both from the middle Miocene of the Dominican Republic, are probably synonyms. *L. heptagona* is more slender than *L. disclusa*, n. sp., and has narrower axials. Its whorls are flatter, its spiral sculpture less prominent, and its anterior canal is shorter.

The holotype of *L. camaronensis* Olsson (1964, p. 110, pl. 20, fig. 3) from the late Miocene or Pliocene of Ecuador is an imperfect shell, its early whorls being strongly worn. The axials are much weaker in *L. camaronensis*, and the pairs of spirals are separated by wider interspaces than in *L. disclusa*.

Occurrence.—Hutch 47, Hutch 51, KR 11862, RR 293, PJ 285, USGS 18399, USGS 18634, USGS 21178.

Distribution.—Savaneta Glauconitic Sandstone Member and Melajo Clay Member, both of Springvale Fm., Trinidad.

Genus **ITHYCYTHARA** Woodring

Woodring, 1928, Carnegie Inst. Washington, Pub. 385, p. 168.

Type species (by original designation). *Mangilia psila* Bush.

***Ithycythara hilaris*, n. sp.**

Pl. 59, figs. 16, 17

Shell small, slender. Protoconch with $2\frac{1}{2}$ smooth whorls. Post-nuclear whorls seven. First sculptured whorl with numerous slightly opisthocyrt axials which gradually become stronger, and a spiral thread at the lower suture which disappears soon. On the second or third postnuclear whorl the number of axials is reduced to six, and the axials remain aligned on successive whorls. Axials angulated somewhat below the middle of the whorl. Later spire whorls and body whorl with faint spiral grooves. Parietal callus smooth. Outer lip thin, with one denticle below the moderately deep anal sinus. Anterior canal moderately long.

Holotype. — Natural History Museum Basel, No. H 15294.

Dimensions of holotype. — Height 5.9 mm, greatest diameter 2.0 mm.

Type locality. — Melajo River area: PJ 285.

This species occurs in the Melajo Clay and is represented by 20 specimens. Many of them, however, are immature or incomplete.

I. hilaris, n. sp. is more slender than *I. rata* Fargo (*in* Olsson and Harbison, 1953, p. 382, pl. 20, figs. 2, 2a) from the Pliocene of Florida. It lacks denticles on the outer lip and has a longer anterior canal. *I. kellumi* Fargo (*in* Olsson and Harbison, 1953, p. 383, pl. 20, fig. 1), also from the Pliocene of Florida, lacks spiral sculpture and has a shallower anal sinus. Adult specimens of the type species of *Ithycythara*, the Recent *I. psila* (Bush) (1885, p. 155, pl. 45, fig. 2) from the southeastern United States, have denticles on the outer lip. *I. psila* is not so slender as *I. hilaris*, n. sp. and lacks spiral sculpture.

Occurrence. — KR 11862, PJ 285, USGS 18399, USGS 21178.

***Ithycythara* species**

A number of apparently immature specimens from the Courbaril beds are not preserved well enough to be described. They seem to differ from *I. hilaris*, n. sp. only by having seven axials per whorls instead of six.

I. scissa Woodring (1928, p. 170, pl. 6, fig. 10) from the Bowden Formation of Jamaica has also seven axials per whorl but is

much larger. Its spiral sculpture causes small beads on part of the axials.

Occurrence. — USGS 10991, USGS 20433.

Genus **ADELOCYTHARA** Woodring

Woodring, 1928, Carnegie Inst. Washington, Pub. 385, p. 171.

Type species (by original designation), *Adelocythara primo-levis* Woodring.

Adelocythara (?) **micropleura** (Guppy)

Pl. 59, figs. 18, 19

1867. *Mangelia micropleura* Guppy, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 159, 171; reprint, Harris, 1921, Bull. Amer. Paleont., vol. 8, No. 35, pp. 38, 50.

1874. *Mangelia micropleura* Guppy, Guppy, Geol. Mag., new ser., decade 2, vol. 1, pp. 410, 440, pl. 18, fig. 6.

1925. *Mangilia micropleura* Guppy, Mansfield, U. S. Nat. Mus., Proc., vol. 66, art. 22, p. 25, pl. 3, fig. 7.

Shell small, solid. Protoconch with about $1\frac{1}{2}$ whorls, not well separated from postnuclear whorls. Postnuclear whorls about five. First sculpture appearing gradually, consists of numerous axials and a spiral which is situated a little below the middle of the whorl. On the second sculptured whorl the axials are much stronger, their number reduced, and the spiral forms a peripheral angulation, which is now situated a little above the middle of the whorl. Late spire whorls with eight or nine axials and one or two distant spirals below the angulation. Body whorl with about six faint spirals below the angulation. Outer lip thickened. Anal sinus conspicuous, denticle below it not prominent. Pillar with several oblique spirals.

Lectotype (herewith selected). — USNM 115583 (specimen figured by Mansfield).

Dimensions of lectotype. — Height 5.0 mm, greatest diameter 2.3 mm.

Type locality. — Matura, Trinidad.

The type lot of *Mangelia micropleura* consists of six specimens. Contrary to Mansfield's statement the lectotype (Mansfield's figured specimen) is not the largest one of the syntypes. The lectotype is a somewhat worn specimen, and its spiral sculpture is not well recognizable. Later collections have yielded better specimens.

Mansfield compared *A.* (?) *micropleura* with *Mangilia plicosa* C. B. Adams. But this is an entirely different form according to

the figure of the lectotype given by Clench and Turner (1950, pl. 31, fig. 1).

This species is tentatively referred to the genus *Adelocythara*. Its protoconch and first sculpture are similar to those of the type species, *A. primolevis* Woodring (1928, p. 171, pl. 6, fig. 11) from the Bowden Formation of Jamaica. *A. primolevis* is smaller, more slender, and has more axials. Its spirals are stronger and cross the axials. In *A. (?) micropleura* the spirals are restricted to the interspaces of the axials.

Occurrence.—JS 67, RR 230, PJ 302, USGS 19860.

Distribution.—Known from type locality only.

Genus **GLYPTAESOPUS** Pilsbry and Olsson

Pilsbry and Olsson, 1941, Acad. Nat. Sci. Philadelphia, Proc., vol. 93, p. 36.

Type species (by original designation), *Aesopus xenicus* Pilsbry and Lowe (= *Mangilia cetolaca* Dall).

According to Radwin (in press) the radula of *Aesopus xenicus* Pilsbry and Lowe (1932, p. 73, pl. 14, fig. 7) indicates that *Glyptaesopus* is a genus of the Turridae. Radwin also shows that *A. xenicus* is a synonym of *Mangilia cetolaca* Dall (1908, p. 286).

Glyptaesopus species

Pl. 60, figs. 1, 2

Shell small, slender. Sculptured whorls $5\frac{1}{2}$. Sculpture consists of two rows of equally spaced nodules which are connected by weak axials and still weaker spirals. Sutures not deeply incised. Body whorl with three or four additional rows of smaller nodules below the periphery. Aperture long. Anterior canal short. Outer lip thin.

This species is represented by two worn specimens from Matura. No protoconch is preserved.

G. xenicus (Pilsbry and Lowe) is a Recent Eastern Pacific form. Its whorls are almost flat in profile. The spiral connections between the nodules are missing. Two species of *Glyptaesopus* are known from the Pliocene of Ecuador. But the Matura specimens are most closely related to *G. proctorae* (M. Smith) (1936a, pl. 9, fig. 14; 1936b, p. 21) originally described from the Pliocene of Florida. *G. coxi* (Fargo) (1948, p. 111, pl. 7, figs. 11, 12), also from the Floridian Pliocene, is considered as a synonym, or a subspecies of *G. proctorae* by Olsson and Harbison (1953, p. 240). The Trini-

dad specimens are more slender than *G. proctorae* and possibly represent a new species.

I am indebted to George E. Radwin for the information that *G. proctorae* has survived to the Recent fauna. So far, however, it is known from two Recent specimens only; one from Andros Island, Bahamas, the other one from the Florida Keys.

Occurrence. — JS 67.

Genus **MIRACLATHURELLA** Woodring

Woodring, 1928, Carnegie Inst. Washington, Pub. 385, p. 189.

Type species (by original designation), *Miraclothurella vittata* Woodring.

Miraclothurella ralla, n. sp.

Pl. 58, figs. 12-14

Of medium to large size, slender. Protoconch consists of a little more than three whorls, the last half whorl with a few opisthocline axials and an angulation on its lower part. Postnuclear whorls up to six. First postnuclear whorl with a subsutural spiral and three spirals on its lower part, which cross broad axial swellings. Anal fasciole of late whorls without axials, on early whorls with axials of reduced size. Axials on late whorls more numerous, but weak. Penultimate whorl with six spirals below anal fasciole. Anal fasciole of late whorls with a few minute spirals and opisthocyrt growth lines. Interspaces of spirals on body whorl with fine spiral threads. Aperture long. Anal sinus deep. Outer lip varicose, with a stromboid notch. Anterior canal long. Parietal callus smooth, thickened near anal sinus.

Holotype. — USNM 645505.

Dimensions of holotype. — Height 15.6 mm, greater diameter 4.8 mm.

Type locality. — Melajo River area: USGS 18399.

M. ralla, n. sp. occurs in the Melajo Clay and is represented by 11 specimens. The number of spirals is somewhat variable. The varix of the outer lip usually carries one secondary spiral between the primary ones.

The type species of *Miraclothurella*, *M. vittata* Woodring (1928, p. 190, pl. 8, figs. 2-4) from the Bowden Formation of Jamaica is smaller, has more axials, and weaker spirals. *M. entemna* Woodring (1928, p. 190, pl. 8, figs. 5, 6) from the Bowden Forma-

tion of Jamaica has somewhat less inflated whorls. It has less spirals on the spire whorls, and the axials are present on the anal fasciole of late whorls.

M. subconsors (Böse) (in Böse and Toula, 1910, p. 250, pl. 13, fig. 25) from the upper Miocene of Mexico has been redescribed by Alencaster-Ibarra (1950, p. 568, fig. 14). The figures are not good enough for comparison. *M. ralla* seems to differ by having more inflated whorls.

Occurrence. — EL 1810, PJ 285, USGS 18399, USGS 21178.

Genus **GLYPHOSTOMA** Gabb

Gabb, 1873, Acad. Nat. Sci. Philadelphia, Proc., for 1872, vol. 24, p. 270.

Type species (by monotypy), *Glyphostoma dentiferum* Gabb.

Glyphostoma sculptile, n. sp.

Pl. 59, figs. 14, 15

Shell small, slender. Spire higher than aperture. Protoconch with $3\frac{1}{2}$ whorls, its last $1\frac{1}{2}$ volutions with a sharp carina a little below the middle of the whorl. Postnuclear whorls almost seven. Sculpture consists of broad axial swellings and two spirals below the anal fasciole on early whorls, three or four spirals on late whorls. Anal fasciole sculptured by a few spiral threads on early whorls, on late whorls by two spiral threads and numerous opisthocyrt wrinkles. There are nine axials on the penultimate whorl. Body whorl with numerous spirals and axials. Anal sinus deep. Inner and outer lips denticulated. Parietal callus greatly thickened near anal sinus, bearing several denticles. Anterior canal moderately long, somewhat wider at base.

Holotype. — Natural History Museum Basel, No. H 15304.

Dimensions of holotype. — Height 14.0 mm, greatest diameter 5.4 mm.

Type locality. — Melajo River area: EL 1810.

This species is based on the holotype and one paratype. Although the paratype is smaller having only $5\frac{1}{2}$ postnuclear whorls, its apertural features are fully developed.

G. sculptile, n. sp. is closely related to *G. golfayaquense* Maury (1917, p. 61, pl. 9, figs. 17, 17a) from the middle Miocene Cercado Formation of the Dominican Republic. Both species are slender and have a low aperture. *G. golfayaquense* essentially differs in having more axials and spirals on late spire whorls.

The Recent *G. myrakeenae* Olsson (1964, p. 110, pl. 18, fig. 4), from off Esmeraldas, Ecuador, has the same number of whorls. It is more slender than *G. sculptile*, n. sp., its aperture is proportionately lower, and it has more axials. The Recent Eastern Pacific *G. adrium* Dall (1919, p. 52, pl. 17, fig. 5) is smaller and has more axials. Its spirals on the spire whorls are broader, and its sculpture on the anal fasciole is weaker. *G. adanum* Dall (1919, p. 52, pl. 17, fig. 1), also from the Recent fauna of the Eastern Pacific, is smaller, more slender, and its axials are less prominent.

None of the forms described by Mansfield (1925, pp. 26-28) from the Brasso Formation of Trinidad represents a species of *Glyphostoma*.

Occurrence. — EL 1810, USGS 21178.

Family TEREBRIDAE

Genus STRIOTEREBRUM Sacco

Sacco, 1891, I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 10, p. 33.

Type species (by original designation), *Terebra basteroti* Nyst.

Strioterebrum cf. **gatunense** (Toula)

Pl. 60, fig. 3

A single shell with eight preserved whorls from the base of the Melajo Clay is available. The subsutural band is well separated from the remainder of the whorl which is sculptured by five spirals of unequal size and inconspicuous, discontinuous axials. No columellar folds developed at aperture.

S. gatunense (Toula) (1909, p. 705, pl. 25, fig. 14) is a widespread middle Miocene species. As pointed out by Rutsch (1934, p. 107) and Olsson (1964, p. 77) *T. wolfgangi* Toula as described and figured by Brown and Pilsbry (1911, p. 340, pl. 22, figs. 1, 3-6) is true *S. gatunense*. Late Miocene representatives of the same group from the Punta Gavilán Formation of Venezuela have been described as *S. gatunense kugleri* by Rutsch (1934, p. 106, pl. 8, figs. 18, 19, pl. 9, figs. 12, 13). They essentially differ by their larger size.

Occurrence. — USGS 18634.

Strioterebrum aff. **laevifasciola** (Maury)

Pl. 60, figs. 4-6

Shell small, moderately slender. Protoconch high, consists of $3\frac{1}{2}$ to 4 whorls. First two sculptured whorls without subsutural

band. Early sculpture consists of about 10 axials which are somewhat broader and higher anteriorly, and a varying number of spiral grooves. The subsutural band appears on the third sculptured whorl and is not ornamented by spirals. Axials slightly prosocline on upper part of whorl numbering about 15 on late whorls. Columella with two low swellings. Siphonal fasciole pronounced. Base of body whorl with closely set spirals.

This form is represented by more than 20 specimens from the Melajo Clay. A few specimens from the Courbaril beds are tentatively referred to the same form as the Melajo shells, but their state of preservation allows a questionable identification only.

The Melajo shells are strongly variable as to strength of sculpture and especially as to spiral sculpture. The groove below the subsutural band is always prominent. Below this groove the spiral sculpture may be restricted to some faint grooves or may be lacking entirely.

Maury (1917, p. 27, pl. 3, fig. 19) described *S. gausapatum laevifasciola* from the middle Miocene Cercado Formation of the Dominican Republic. Protoconch and early sculptured whorls were not described. The later whorls are similar to those of the Melajo shells, except that the axials are not crossed by the spirals in the Dominican species.

S. cambiarsoi (Maury) (1917, p. 27, pl. 3, fig. 20), also from the Cercado Formation of the Dominican Republic, is smaller, and has more axials which are not thickened on the lower part of early whorls. The protoconch, however, is similar. The Melajo shells usually have more spirals, but specimens with three spiral grooves below the subsutural band occur. *S. cambiarsoi nugatorium* (Woodring) (1928, p. 142, pl. 4, figs. 2, 3) from the Bowden Formation of Jamaica has few spiral grooves below the subsutural band like some of the Melajo shells, but its protoconch consists of two whorls only.

S. brechincastrense (Rutsch) (1942, p. 172, pl. 4, figs. 9a, 9b) from the Savaneta Glauconitic Sandstone Member of the Springvale Formation of Trinidad is larger, and has less, but stronger and higher axials which give a convex appearance to the whorls.

Occurrence.—Melajo River area: EL 1810, KR 11862, RR 290, PJ 285. Point Courbaril: K 1429 (?), PJ 212 (?).

Strioterebrum aff. **baculiforme** (Pilsbry and Johnson) Pl. 60, figs. 8, 9

Shell small, slender. Early whorls almost flat in profile, late whorls somewhat convex. Protoconch stout, consists of $1\frac{1}{2}$ whorls. First postnuclear whorl sculptured by axials only. Subsutural band appearing on second or third sculptured whorl. Late whorls with 17 to 20 opisthocyrt axials and about five spirals with interspaces of varying width. Groove below subsutural band moderately pronounced. Columella with a low, basal swelling. Siphonal fasciole bordered by a sharp ridge.

S. aff. *baculiforme* is represented by 13 specimens from the Melajo Clay. The convexity of the whorls, the number of the spirals, and the width of their interspaces are variable to some degree. The shape of the axials is only slightly affected when crossed by the spirals, although there are some exceptions.

The Miocene *S. baculiforme* (Pilsbry and Johnson) (1917, p. 152; Pilsbry 1922, p. 316, pl. 22, figs. 5, 6) from the Dominican Republic essentially is a larger species with more strongly opisthocyrt axials. Apparently its axials are less reduced in strength when crossing the groove below the subsutural band than it is the case in the Melajo shells. The subsutural band of Melajo specimens is not sculptured by spirals as in *S. baculiforme*. *S. baculiforme* has been cited from the middle Miocene of Mexico by Alencaster-Ibarra (1950, p. 563, fig. 7), but the figure is unrecognizable.

S. berlinerae (Maury) (1917, p. 34, pl. 4, figs. 7, 8) from the Cercado Formation of the Dominican Republic is considerably larger, stouter, and has many more axials. *Terebra* (*Strioterebrum*) species c of Woodring (1928, p. 140, pl. 3, fig. 16) from the Bowden Formation of Jamaica has also somewhat convex whorls, but its axials are almost orthocline.

Occurrence. — K 9816, RR 290, PJ 285.

Strioterebrum species

Nine specimens from Matura are insufficiently preserved for full description and statements on affinities. They are small and slender, sculptured by numerous orthocline to slightly opisthocyrt axials and six to seven spirals. Subsutural band well separated from remainder of whorl. No protoconch preserved. Columella with an inconspicuous basal swelling.

Occurrence. — JS 67, RR 230, PJ 302.

Genus **HASTULA** H. and A. Adams

H. and A. Adams, 1853, *The Genera of Recent Mollusca*, vol. 1, p. 225.

Type species (by subsequent designation, Cossmann, 1896, *Essais de paléoconchologie comparée*, pt. 2, p. 53), *Buccinum strigilatum* Linné.

Hastula aff. **hastata** (Gmelin)

Pl. 60, fig. 7

Four worn fragments from Matura are available. One of them has its protoconch preserved. It consists of almost four whorls and is indistinguishable from that of the Recent Caribbean *H. hastata*. The third whorl of the protoconch is considerably higher than the fourth one.

Recent shells of *H. hastata* have about the same number of axials per whorl as the Matura specimens, whereas *H. hastata mareana* (Weisbord) (1962, p. 434, pl. 41, figs. 9-12) from the Pliocene of Venezuela is distinguished by its higher number of axials.

Matura specimens are more slender than Recent shells. The diameter of their whorls increases regularly, whereas in Recent shells the degree of increase is not regular. In this respect the Matura specimens resemble *H. vautrini* Jung (1965, p. 594) from Bowden, Jamaica. In that species, however, the axials are not persistent from suture to suture.

Occurrence. — RR 230, PJ 302.

Family **PYRAMIDELLIDAE**Genus **PYRAMIDELLA** Lamarck

Lamarck, 1799, *Mém. Soc. Hist. Nat. Paris*, p. 76.

Type species (by monotypy), *Trochus dolabratus* Linné.

See also Opinion 386, *Opinions and declarations rendered by the International Commission on Zoological Nomenclature*, vol. 12, pt. 7, pp. 231-240, 1956.

Subgenus **LONGCHAEUS** Mörch

Mörch, 1875, *Malakozool. Blätter*, vol. 22, p. 158.

Type species (by subsequent designation, Dall and Bartsch, 1909, U. S. National Museum, Bull. 68, p. 21), *Pyramidella punctata* Schubert and Wagner.

Pyramidella (**Longchaeus** ?) species A .

Pl. 60, fig. 10

Of medium size. Shape somewhat pupiform. Protoconch not

preserved. Whorls with faint, short axial markings at upper suture, and a moderately pronounced spiral sulcus near lower suture. Uppermost columellar fold sharp, the two lower ones weak. Inner surface of outer lip lirate at some distance from the margin. Columellar callus thick.

This form is represented by a single specimen (height 10.0 mm, diameter 3.2 mm) from Matura. Although it is strongly worn, faint axials can be recognized in the spiral sulcus. Its state of preservation is not good enough to allow satisfactory comparisons.

Occurrence. — RR 230.

Subgenus **CALLOLONGCHAEUS** Dall and Bartsch

Dall and Bartsch, 1904, Biol. Soc. Washington, Proc., vol. 17, p. 5.

Type species (by original designation), *Pyramidella* (*Longchaeus*) *jamaicensis* Dall.

Pyramidella (*Callolongchaeus*) aff. *jamaicensis* Dall Pl. 60, fig. 11

Shell small, moderately slender. Peripheral sulcus situated at some distance from lower suture, deep, and crossed by numerous narrow axials. Surface of whorls polished except a narrow zone below the upper suture which is sculptured by short axials. Uppermost columellar fold conspicuous, the two lower ones weaker and more oblique. Columellar callus thick. Siphonal fasciole slightly bulging. Inner surface of outer lip with two denticles at some distance from the margin.

This species is represented by a few mostly immature specimens from the Melajo Clay. *P. jamaicensis* Dall (in Guppy and Dall, 1896, p. 315, pl. 29, fig. 10) from the Bowden Formation of Jamaica was based on an immature specimen measuring 3.25 mm in height. Topotypes at hand reach a height of more than 20 mm, although they are incomplete. Larger topotypes have two lirae within the aperture (as opposed to denticles in the Melajo specimens), although *P. jamaicensis* had originally been described as "non lirate inside." The Melajo specimens differ from *P. jamaicensis* in having a broader sculptured zone below the suture. The upper border of the peripheral sulcus is sharper in Melajo shells, and their whorls are more constricted in their upper part.

Maury (1917, pp. 144-146) described several species of *Pyramidella* from the Miocene of the Dominican Republic. The insuffi-

cient quality of her figures and the lack of topotypes do not allow to give comparative remarks. Maury compared her *P. cercadensis* (1917, p. 146, pl. 25, fig. 9) with *P. jamaicensis*. The type of *P. cercadensis* probably is immature as well.

Occurrence. — KR 11862, RR 293, PJ 285.

Pyramidella (Callolongchaeus) cf. diademata Maury Pl. 60, fig. 12

Shell small, moderately slender. Peripheral sulcus close to the lower suture; crossed by faint axials. Uppermost part of whorl finely crenulated. Uppermost columellar fold sharp, the two lower ones smaller. Inner surface of outer lip with two lirae well within the aperture. Siphonal fasciole somewhat bulging.

This species is represented by three immature specimens from the Melajo Clay. *P. diademata* Maury (1917, p. 145, pl. 25, fig. 7) from the middle Miocene Cercado Formation of the Dominican Republic differs from Melajo shells in being larger, and in having four denticles on the outer lip. The anterior border of the peripheral sulcus on the body whorl is crenulated in the Dominican species.

Occurrence. — KR 11862, PJ 285.

Genus **TRIPTYCHUS** Mörch

Mörsch, 1875, Malakozool. Blätter, vol. 22, p. 158.

Type species (by monotypy), *Obeliscus (Triptychus) niveus* Mörsch.

Subgenus **PERISTICHIA** Dall

Dall, 1889, Mus. Comp. Zool., Bull.; vol. 18, p. 339.

Type species (by original designation), *Peristichia toreta* Dall.

Triptychus (Peristichia) species

A single, immature specimen from Matura is available. The protoconch and $4\frac{1}{2}$ postnuclear whorls are preserved. The sinistral protoconch consists of a little more than two whorls, and its axis is at right angles to the main shell axis. The first postnuclear whorl is sculptured by two prominent spiral ribs and numerous axials. On the second sculptured whorl a third spiral rib appears near the upper suture which becomes more prominent on later whorls. Last preserved whorls with a fourth spiral rib at the periphery, and another spiral on the base which continues into the aperture. The spirals form small nodes when crossed by the axials.

Although somewhat worn this immature Matura shell is almost identical with the young stages of *Turbonilla* (*Peristichia*) ? *springvaleensis* Rutsch (1942, p. 137, pl. 6, fig. 6) which had been described from the Savaneta Glauconitic Sandstone Member of the Springvale Formation of Trinidad. The protoconch of the Matura shell is somewhat smaller. The holotype of the Springvale species apparently is an adult shell. Its outer and basal lips are somewhat thickened, and the inner surface of the outer lip carries three denticles. The lack of these denticles in the Matura shell is possibly due to its immaturity.

The type species of *Peristichia*, the Recent *P. toreta* Dall (1889, pl. 42, fig. 10; 1889a, p. 340) from the southeastern coast of the United States is a larger species. Its nodes at the intersections of spirals and axials are much more pronounced, but its axial sculpture is weaker. *Peristichia agria* Dall (1889a, p. 340) has not been figured. According to the original description it is smaller than *P. toreta*, and the nodules are scarcely developed.

T. springvaleensis and the Matura specimen need comparison with the Recent West Mexican *T. hermosus* (Lowe) (1935, p. 22, pl. 3, fig. 4), *T. pliocena* Bartsch (1955, p. 8, pl. 1, fig. 1), and *Peristichia martschi* Bartsch (1955, p. 16, pl. 2, fig. 6), both from the Pliocene of Florida, and *Cerithium lordlyi* Gabb (1881b, p. 362, pl. 46, fig. 55) from the Pliocene of Costa Rica.

Occurrence. — PJ 302.

Genus **EULIMELLA** Forbes

Forbes, 1847, in Jeffreys, Ann. Mag. Nat. Hist., vol. 19, p. 311.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc. pt. 15, p. 160), *Eulimella crassula* Jeffreys (= *Melania scillae* Scacchi).

Subgenus **EULIMELLA** s. str.

Eulimella (**Eulimella**) species A

Pl. 60, fig. 13

Shell small, slender. Protoconch with a little less than two whorls, sinistral; its axis at about right angles to the main shell axis. Postnuclear whorls nine, polished, rounded to slightly angulated at periphery, which is situated on lower half of whorl. Aperture somewhat squarish. Columella with two faint folds. These folds are not visible, if the aperture is complete.

This species is represented by three specimens from the Melajo Clay. Although they have many postnuclear whorls, they are probably immature. Protoconch and early whorls of *E. tenuilineata* (Guppy) (in Guppy and Dall, 1896, p. 317, pl. 28, fig. 8) from the Bowden Formation of Jamaica are not known. The whorls of the Melajo shells are more constricted at the suture. *E. tenuilineata* has some faint spirals below the periphery which are lacking in *E. species A*. The Miocene *E. turritelloides* (Gabb) (1873b, p. 226; Pilsbry, 1922, p. 391, pl. 36, fig. 1) from the Dominican Republic has even more spirals than *E. tenuilineata* and its protoconch is larger than that of the Melajo shells. The whorls of *E. tampaensis* Bartsch (1955, p. 13, pl. 2, fig. 1) from the Pliocene of Florida are less constricted at the suture. *E. tampaensis* lacks spiral sculpture like *E. species A*.

Occurrence. — KR 11862.

Subgenus **EBALINA** Thiele

Thiele, 1929, Handbuch der systematischen Weichtierkunde. Erster Teil, p. 236.

Type species (by monotypy), *Eulimella* (*Ebalina*) *monolivata* (Folin).

***Eulimella* (*Ebalina*) *mitis*, n. sp.**

Pl. 60, figs. 14, 15

Shell small, slender. Protoconch sinistral, consists of almost two whorls; its axis at about right angles to the main shell axis. Postnuclear whorls up to 14, polished. The first two postnuclear whorls with an angulation on the lower half of the whorl. On the third postnuclear whorl a smooth subsutural band appears, which gradually increases in strength. Space between subsutural band and angulation on lower part of whorl slightly concave. Aperture somewhat squarish. Columella straight, with two faint folds, which are not visible, if the aperture is complete.

Holotype. — Natural History Museum Basel, No. H 15362.

Dimensions of holotype. — Height 5.6 mm, diameter 1.1 mm.

Type locality. — Melajo River area: PJ 285.

This species is represented from the Melajo Clay by more than a hundred specimens. The prominence of the angulation on the lower half of the whorl is strongly variable. The whorls of some specimens are almost regularly convex below the subsutural band,

in others, however, this angulation may develop almost into a keel. These extremes are connected by transitions.

A single specimen from the Matura shell bed is also identified as *E. mitis*, n. sp. No related species have been found.

Occurrence. — Melajo River area: KR 11862, PJ 285. Matura Bay: PJ 302.

Genus **TURBONILLA** Risso

Risso, 1826, *Histoire naturelle des principales productions de l'Europe méridionale*, vol. 4, p. 224.

Type species (by subsequent designation, Herrmannsen, 1852, *Indicis generum malacozoorum. Supplementa et corrigenda*, p. 136), *Turbonilla costulata* Risso. See also Palmer (1958, p. 251).

The following merely is a record of the *Turbonillas* occurring in the faunas under consideration. Despite the works of Dall and Bartsch (1904, 1909) and Bartsch (1955) no attempt is made to assign the different forms to subgenera as this would require a large comparative material which is not at hand. The lack of comparative material also prevents the use of specific names.

Turbonilla species A

Pl. 60, figs. 16, 17

Shell small, slender. Protoconch consists of about $21\frac{1}{2}$ whorls; its axis at a little more than right angles to the main shell axis. The apex is slightly overhanging the upper suture of the first post-nuclear whorl. Postnuclear whorls up to 10, somewhat convex. Sculpture consists of numerous opisthocline to slightly opisthocyrt axials with smooth interspaces of about the same width. Suture conspicuously incised. Base smooth. Aperture angulated above. Columellar fold not visible at aperture.

This form is abundant at Matura. It is stated above that the interspaces of the axials are smooth. However, there are some fragments representing late whorls which show microscopic spiral striation. This striation is probably easily washed away.

Turbonilla species A shows considerable variation as to width and shape of the axials. In some rare cases they are straight. Usually they are opisthocline to slightly opisthocyrt, but in some shells they are sigmoid. The interspaces stop abruptly at the periphery of the body whorl.

A few small, immature specimens from the Melajo Clay are identified as *Turbonilla* species A as well.

Occurrence. — Melajo River area: KR 11862, PJ 285. Matura Bay: K 10924, JS 67, RR 230, PJ 302.

Turbonilla species B

Pl. 60, fig. 18

Shell small, moderately slender. Protoconch consists of about $2\frac{1}{2}$ whorls, its axis at about 100° to the main shell axis. Apex slightly overhanging upper suture of first postnuclear whorl. Sculpture consists of almost orthocline axials and faint spiral grooves in the interspaces. Whorls somewhat inflated. Sculpture stops abruptly at periphery of body whorl. Base smooth. Columella straight, without fold at aperture.

This species is represented by about 20 specimens from the Melajo Clay. It has the same protoconch as *Turbonilla* species A, but differs by having spiral sculpture, more inflated whorls, broader interspaces, and less axials.

Occurrence. — EL 1810, KR 11862, PJ 285.

Turbonilla species C

Pl. 60, fig. 19

Shell small, moderately slender. Protoconch consists of about two whorls, its axis at a little more than right angles to the main shell axis. Whorls practically straight in profile. Sculpture consists of orthocline axials; their interspaces crossed by a varying number of fine spiral threads. Below the periphery of the body whorl the axials gradually disappear, whereas the strength of the spirals increases on the base. Columella with one conspicuous fold. Outer lip partly lirate within.

This species is abundant at Matura. The liration of the inner surface of the outer lip is not developed throughout the ontogeny of the shell. Although the specimens with liration include different ontogenetic stages, the liration is not visible on others.

Occurrence. — JS 67, RR 230, PJ 302.

Turbonilla species D

Pl. 60, figs. 20, 21

Shell small, slender. Protoconch consists of two whorls; its axis at about right angles to the main shell axis. Sculpture consists of orthocline axials with interspaces crossed by spiral grooves. The interspaces are narrow on early whorls, wider on late whorls. One spiral groove on the upper half of the whorls is wider and deeper than the others. Base sculptured by spiral grooves and weak

axials. Basal lip somewhat everted. Outer lip without lirations. Columella with one fold.

This species is abundant in the Melajo Clay. Its slenderness and the pronounced spiral groove on the upper half of the whorl are characteristic.

Occurrence. — EL 1810, KR 11862, K 9797, PJ 285.

Turbonilla species E

Pl. 60, fig. 22

Shell small, slender. Protoconch consists of about two whorls; its axis at about right angles to the main shell axis. Sculpture consists of almost orthocline axials and numerous spirals in the interspaces. Whorls evenly convex. Sutures well incised. On the first three or four sculptured whorls the axials are closely set. Later the interspaces become wider. Columellar fold hardly visible at aperture. Base sculptured by spirals and weak axials. Outer lip smooth within.

This species is represented by about 35 specimens from the Melajo Clay. The evenly convex whorls and the closely set axials on early whorls are characteristic features.

Occurrence. — EL 1810, KR 11862, PJ 285.

Genus ODOSTOMIA Fleming

Fleming, 1813, Brewster's Edinburgh Encyclopedia, vol. 7, pt. 1, p. 76.

Type species (by subsequent designation, Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 159), *Turbo plicatus* Montagu.

Odostomia canaliculata C. B. Adams ?

Pl. 60, fig. 23

Shell small, moderately stout. Protoconch small, sinistral. Post-nuclear whorls six, straight in profile, polished. Suture somewhat channeled. Body whorl slightly angulated at periphery. Columella with one strong, almost horizontal fold. Umbilicus inconspicuous. Basal lip slightly everted.

O. canaliculata C. B. Adams is a Recent West Indian species which had originally been described from Jamaica. Clench and Turner (1950, p. 262, pl. 40, fig. 3) figured the lectotype. According to this figure the two shells from Matura are slightly stouter but otherwise indistinguishable. Abbott (1958, p. 103) was inclined to treat *O. canaliculata* as a synonym of *O. laevigata* (d'Orbigny), but Warmke and Abbott (1961, p. 148, pl. 26 1) considered it as a separate species.

O. mareana Weisbord (1962, p. 465, pl. 44, figs. 5, 6) from the lower Mare Formation (Pliocene) of northern Venezuela is based on a single specimen. It is not unlikely that it represents *O. canaliculata*. Maury (1917, p. 151, pl. 25, fig. 22) described *O. yaquica* from the middle Miocene Cerado Formation of the Dominican Republic, but the figure is insufficient for comparison.

Occurrence. — RR 230.

Subgenus **SALASSIA** de Folin

Folin, 1885, Const. d. Chemnitzidae, p. 15 (not seen).

Type species, *Odostomia (Salassia) tropidita* Dall and Bartsch (quoted from Dall and Bartsch, 1909, p. 134).

Odostomia (Salassia ?) species

Pl. 60, fig. 24

Shell small, moderately slender. Protoconch with about two whorls, somewhat sunken into first spire whorl, its axis at about 135° to the main shell axis. Postnuclear whorls five, slightly convex. Sculpture consists of broad, rounded axials reaching from suture to suture. Interspaces smooth. Number of axials on body whorl 14. Axials on body whorl gradually disappearing below periphery. Aperture angulated above. Outer lip thin. No umbilicus. Columellar callus conspicuous, with one low fold.

This form occurs in the Matura shell bed but is represented only by two worn specimens. According to Dall and Bartsch (1909, p. 134) *Salassia* is characterised, among other things, by tabulated whorls. This, however, is not the case in the Matura shells. The shape of their whorls is more like that of *Salassietta* Dall and Bartsch (1909, p. 133; type species by original designation, *Odostomia (Salassietta) laxa* Dall and Bartsch), but *Salassietta* has occasional varices.

A similarly uncharacteristic *Salassia* is the Recent West American *O. hertleini* Strong (1938, p. 205, pl. 15, fig. 9). Its whorls are not tabulated, and it is more pupiform than the Matura shells.

Occurrence. — RR 230.

Family **ACTEONIDAE**

Genus **RICTAXIS** Dall

Dall, 1871, Amer. Jour. Conch., vol. 7, pt. 2, p. 136.

Type species (by original designation), *Tornatella punctocaelata* Carpenter.

Rictaxis species

Three small specimens (height 4 mm) with $1\frac{1}{2}$ sculptured whorls from the Melajo Clay are available. They are too immature to be compared with *R. oryza* (Gabb) (1873a, p. 273, pl. 11, figs. 8, 8a; 1873b, p. 245; Pilsbry 1922, p. 310, pl. 23, fig. 12) from the Miocene of the Dominican Republic or with *R. myakkanus* (Dall) [1896a, p. 24; 1890-1903 (1903), pl. 59, fig. 1; Olsson and Harbison, 1953, p. 158, pl. 25, figs. 5, 5a] from the Pliocene of Florida. The Melajo specimens have the same type of spiral sculpture as the two species mentioned above.

Occurrence. — PJ 285, USGS 18399.

Family SCAPHANDRIDAE**Genus ACTEOCINA Gray**

Gray, 1847, Zool. Soc. London, Proc., pt. 15, p. 160.

Type species (by original designation), *Acteon wetherelli* Lea (= *Volvaria canaliculata* Say).

Acteocina canaliculata (Say) ?

Pl. 60 figs. 25, 26

This species is represented from Matura and the Melajo Clay by a few specimens. Matura shells usually have an elevated spire with strongly shouldered whorls. Protoconch with a little more than one volution, heterostrophic, its axis horizontal. Columella with one fold. Inner lip with callus.

A. canaliculata (Say) (1826, p. 211) is said to range from Miocene to Recent. Maury (1917, p. 13, pl. 3, fig. 2) figured a specimen from the middle Miocene of the Dominican Republic measuring 3 mm in height; Olsson and Harbison (1953, pl. 25, fig. 6) figured a 5.1 mm high shell from the Pliocene of Florida, but the Matura and Melajo shells do not attain 3 mm in height and may be immature.

Guppy (1867, p. 155; reprint, Harris, 1921, p. 34) and Guppy (1874, p. 437) cited *Tornatina canaliculata* (d'Orbigny) from Matura, a species which is not represented in the material available, if Guppy really meant *Bulla canaliculata* d'Orbigny (1845, p. 68; Atlas, pl. 4 bis, figs. 21-24, 1842).

A. persimilis (Dall) [1896a, p. 26; 1890-1903 (1903), pl. 59, fig. 22] from the Chipola Formation of Florida is a strikingly similar species. It has about the same dimensions and proportions,

but the Matura shells have a stronger columellar fold, and their outer lip is not constricted posteriorly. *A. lepta* Woodring (1928, p. 121, pl. 2, fig. 5) from the Bowden Formation of Jamaica is a proportionately higher species with straight sides.

Occurrence.—Melajo River area: KR 11862, RR 293, PJ 285, USGS 18399. Matura Bay: K 10924, RR 230, PJ 302.

Genus **CYLICHNELLA** Gabb

Gabb, 1873, Acad. Nat. Sci. Philadelphia, Proc., for 1872, p. 273.

Type species (by monotypy), *Bulla bidentata* d'Orbigny.

Cyllichnella altera, n. sp.

Pl. 60, figs. 27, 28

Shell small, cylindrical, relatively solid. Spire sunken. Apex covered by callus. Outer lip thin, slightly constricted just above the middle of its height. Aperture broadens toward base. Columella with one strong, oblique fold. Surface smooth except for a few spiral, incised lines near the base.

Holotype.—Natural History Museum Basel, No. H 14550.

Dimensions of holotype.—Height 2.6 mm, diameter 1.4 mm.

Type locality.—Melajo River area: KR 11862.

This species is represented by about 20 specimens from the Melajo Clay. Its general shape is somewhat variable. Usually it is elongate, but stouter shells occur as well.

The type lot of *C. ovumlacerti* (Guppy) (1867, p. 168; reprint, Harris, 1921, p. 47) from the middle Miocene Manzanilla Formation of Manzanilla coast, Trinidad, consists of 10 specimens (USNM 115435). One of the syntypes has been figured by Mansfield (1925, pl. 1, figs. 7, 9). *C. ovumlacerti* has spiral, incised lines near the base like *C. altera* but differs in being larger and stouter, and in having a thicker shell.

According to topotypes *C. atacata* Woodring (1928, p. 124, pl. 2, fig. 9) from the Bowden Formation of Jamaica is a somewhat smaller and stouter species with a heavier shell. *C. triticumtritoni* (Maury) (1917, p. 14, pl. 3, fig. 4) from the middle Miocene Cercado Formation of the Dominican Republic essentially is a stouter form. *C. jacksonensis* Mansfield (1930, p. 28, pl. 1, fig. 11) from the upper Miocene of Florida is also a stouter species. Its outer lip descends more rapidly from the apex than in the Melajo form. *C. gabbi* (Dall) (1896a, p. 27; 1890-1903 (1903), pl. 59, fig. 12) from the Pliocene of Florida is a similar but larger species.

The specimen figured by Olsson and Harbison (1953, pl. 25, fig. 8) is a stouter shell which is probably not adult. *C. marcana* Weisbord (1962, p. 458, pl. 47, figs. 1, 2) from the Pliocene Mare Formation of the Cabo Blanco area, Venezuela, has no surface ornamentation. The type of *C. marcana* may be an immature shell. The Recent Caribbean *C. bidentata* (d'Orbigny) (1845, p. 63; Atlas, pl. 4, figs. 13-16, 1842) is clearly distinguished from *C. altera*, n. sp. by its spiral striae spread all over the body whorl.

Occurrence. — KR 11862, PJ 285, USGS 18399.

Cylichnella species

A few poorly preserved shells from the Courbaril beds are even more slender than *C. altera*, n. sp. from the Melajo Clay. Their surface sculpture consists of a few spiral, incised lines near the base.

Occurrence. — USGS 20433, USGS 20434.

Family RETUSIDAE

Genus SULCORETUSA Burch

Burch, 1945, Minutes Conch. Club Southern California, No. 47, p. 16. New name for *Sulcularia* Dall (1921a, p. 202), not *Sulcularia* Rafinesque, 1831.

Type species (= type species of *Sulcularia* Dall), *Bulla sulcata* d'Orbigny.

Sulcoretusa aff. sulcata (d'Orbigny)

Pl. 60, figs. 29, 30

This form is represented by a single specimen from the Melajo Clay. It differs from the Recent *S. sulcata* (d'Orbigny) (1845, p. 66; Atlas, pl. 4 bis, figs. 9-12, 1842) by its narrower shape. *S. sulcata harveyensis* (Mansfield) (1930, p. 27, pl. 1, figs. 6, 7) from the upper Miocene of Florida is narrower posteriorly and has somewhat coarser sulcations. *S. lipara* (Woodring) (1928, p. 123, pl. 2, fig. 8) from the Bowden Formation of Jamaica is a stouter species, has coarser sulcations, and a pronounced constriction in the middle of the shell which is almost lacking in the Melajo specimen. Analogues from the Miocene of the Dominican Republic have been described as *S. sulcata fossilis* by Pilsbry (1922, p. 311). *S. prosulcata* (Gardner) [1926-1950 (1937), p. 265, pl. 37, fig. 19] from the Chipola Formation of Florida has proportions similar to those of the Melajo shell but reaches twice its size. *S. prosulcata* has also been cited from the Pliocene of Florida (Olsson and Harbison, 1953, p. 161).

Occurrence. — PJ 285.

Genus **RHIZORUS** Montfort

Montfort, 1810, *Conchyliologie systématique*, vol. 2, p. 339.

Type species (by original designation). *Rhizorus adalaidis* Montfort (= *Bulla acuminata* Bruguière).

Rhizorus species A

A single fragment (H 14559) from the Matura beds is available. A determination is not possible, although it seems to be closest to *R. oxytatus* (Bush) (1885, p. 468, pl. 45, fig. 12), a species ranging from Miocene to Recent (Woodring, 1928, p. 125). The Matura specimen lacks spiral grooves which may be due to washing.

Occurrence. — RR 230.

Rhizorus species B

There is a single shell (H 14560) from the Melajo Clay the base of which is missing. The genus *Rhizorus* usually includes forms which are swollen in the middle of the height. But the Melajo specimen has parallel sides, thus reminds one of *R. phoinicoides* (Gardner) [1926-1950 (1937), p. 268, pl. 37, fig. 26] from the Shoal River Formation of Florida and *R. triticus* (Olsson and Harbison) (1953, p. 163, pl. 25, figs. 3, 3a) from the Pliocene of Florida.

Occurrence. — PJ 285.

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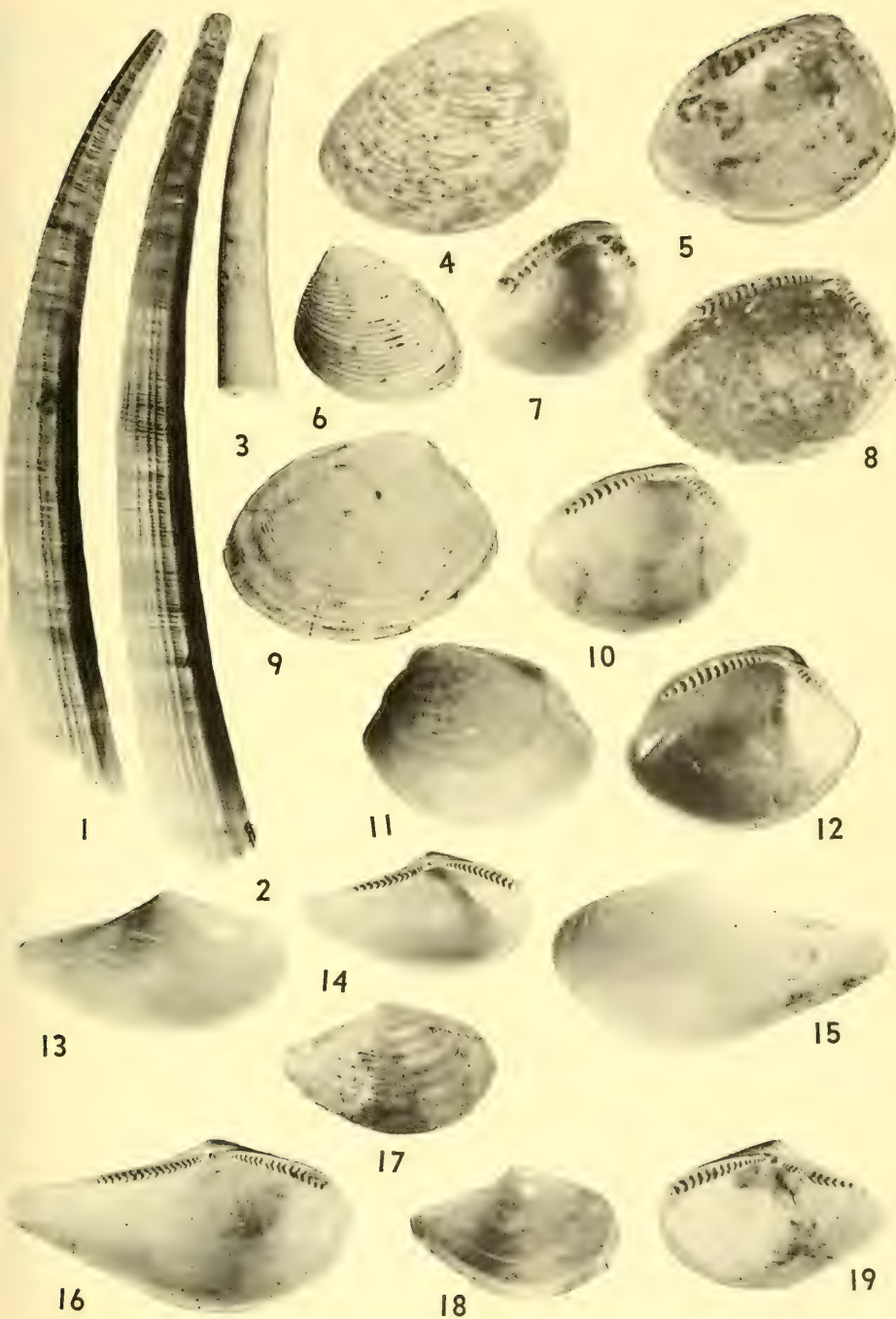
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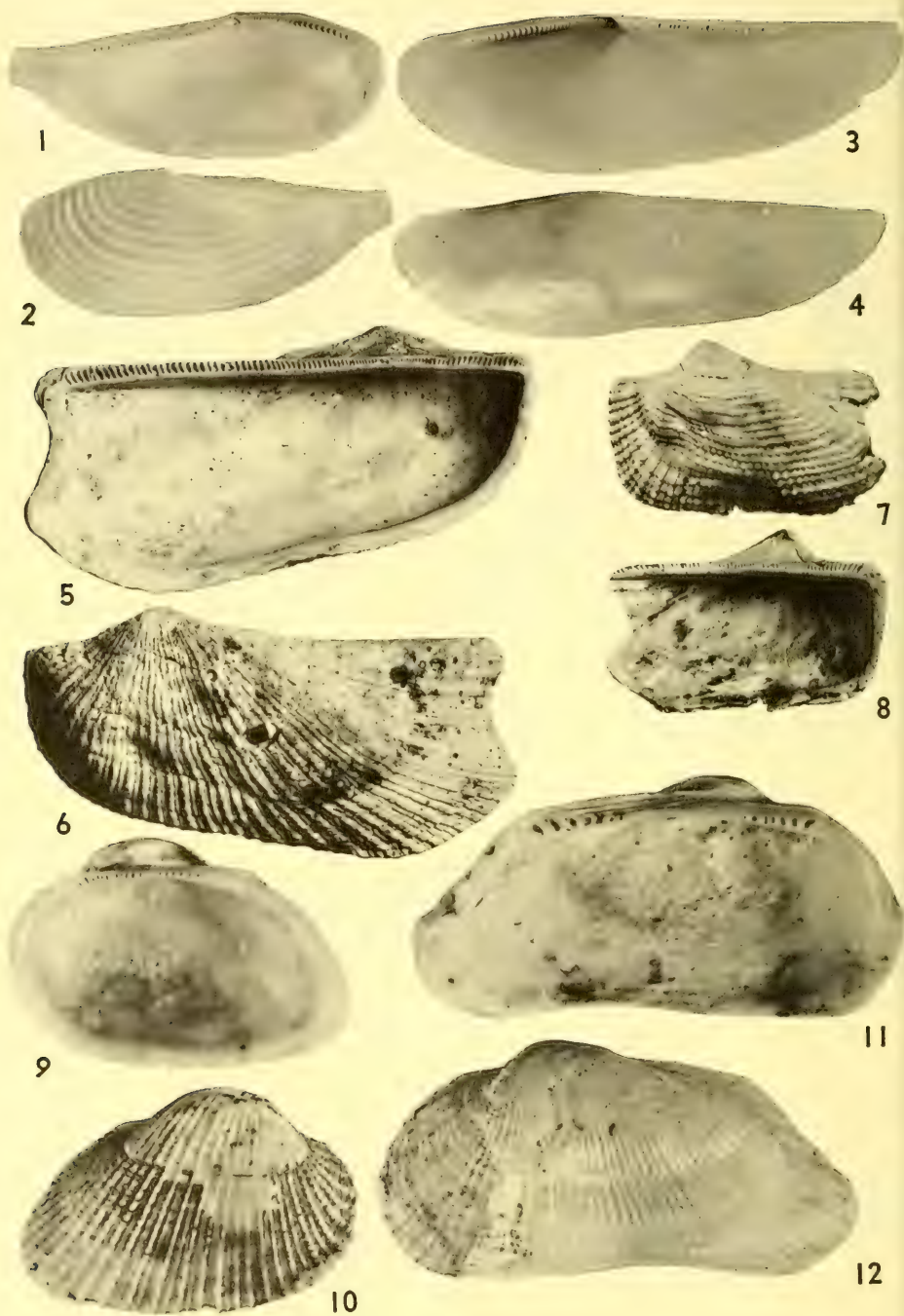
PLATES

If not otherwise specified the number accompanying each specimen refers to the catalogue of the Naturhistorisches Museum Basel (G includes Pelecypoda and Scaphopoda, H Gastropoda).

EXPLANATION OF PLATE 13

Figure		Page
1,2.	Dentalium (Dentalium) divulgatum , n. sp.	313
	1. Holotype. Length 33.5 mm, max. diameter 3.8 mm. Locality PJ 285. No. G 12718. 2. Paratype. Length 37.5 mm, max. diameter 4.1 mm. Locality PJ 285. No. G 12719.	
3.	Dentalium (Graptacme) cf. amaliense Henderson	315
	Length 10.1 mm, max. diameter 1.6 mm. Locality JS 67. No. G 12748.	
4-7.	Nucula (Lamellinucula) vieta Guppy	316
	4. Lectotype. Length 3.1 mm, height 3.1 mm. Matura, coll. Guppy. USNM 115562. 5. Paralectotype. Length 3.3 mm, height 3.0 mm. Matura, coll. Guppy. USNM 645368. 6,7. Length 4.9 mm, height 4.1 mm. Locality JS 67. No. G 12708.	
8-12.	Nucula (Lamellinucula) baccata Guppy	317
	8. Lectotype. Length 7.0 mm, height 5.3 mm. Matura, coll. Guppy. USNM 115561. 9. Length 7.9 mm, height 6.0 mm. Locality JS 67. No. G 12710. 10. Length 6.2 mm, height 4.6 mm. Locality JS 67. No. G 12711. 11,12. Length 6.6 mm, height 5.1 mm. Locality K 9817. No. G 12717.	
13-16.	Nuculana (Saccella) ludificans , n. sp.	319
	13. Holotype. Length 7.4 mm, height 3.7 mm. Locality PJ 285. No. G 12677. 14. Paratype. Length 6.3 mm, height 3.6 mm. Locality PJ 285. No. G 12676. 15. Paratype. Length 9.3 mm, height 5.1 mm. Locality PJ 212. No. G 12684. 16. Paratype. Length 9.6 mm, height 5.0 mm. Locality PJ 212. No. G 12683.	
17-19.	Nuculana (Saccella) perlepida (Guppy)	320
	17. Lectotype. Length 6.0 mm, height 3.8 mm. Matura, coll. Guppy. USNM 115557. 18. Length 5.9 mm, height 3.8 mm. Locality JS 67. No. G 12682. 19. Length 6.3 mm, height 4.2 mm. Locality RR 230. No. G 12681.	



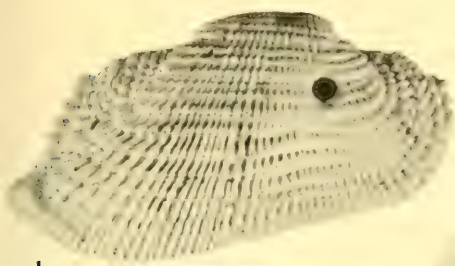


EXPLANATION OF PLATE 14

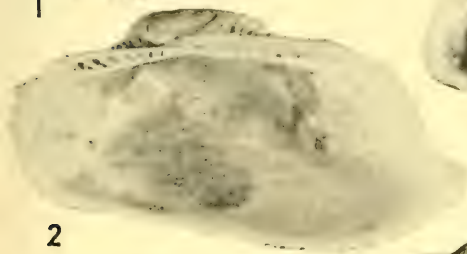
Figure		Page
1,2.	Calorhadia (Calorhadia) solivaga , n. sp.	322
	Holotype. Length 17.0 mm, height 6.5 mm. Locality PJ 285, No. G 12678.	
3,4.	Adrana perprotracta (Dall) ?	323
	3. Length 23.1 mm, height 7.2 mm. Locality PJ 285, No. G 12679.	
	4. Length 22.4 mm, height 6.7 mm. Locality PJ 285, No. G 12680.	
5,6.	Arca (Arca) zebra zebra (Swainson)	325
	Length 45.5 mm, height 22.8 mm. Locality RR 230, No. G 12744.	
7,8.	Arca (Arca) imbricata imbricata Bruguière	326
	Length 25.3 mm, height 17.0 mm. Locality RR 230, No. G 12750.	
9,10.	Barbatia (Fugleria ?) millifila latrinidadis Maury	328
	Length 15.7 mm, height 10.5 mm. Locality RR 230, No. G 12867	
11,12.	Barbatia (Barbatia) candida (Helbling)	327
	Length 22.3 mm, height 11.3 mm, Locality RR 230, No. G 12866.	

EXPLANATION OF PLATE 15

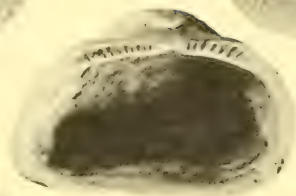
Figure	Page
1.2. Barbatia (Acar) domingensis (Lamarck)	328
Length 20.3 mm, height 11.1 mm. Locality RR 230. No. G 12752.	
3-6. Arcopsis adamsi (Dall)	330
3,4. Length 12.4 mm, height 8.2 mm. Locality RR 230. No. G 12874. 5. Length 11.1 mm, height 7.3 mm. Locality RR 230. No. G 12875. 6. Length 6.5 mm, height 3.9 mm. Locality PJ 302. No. G 12876.	
7. Anadara (Cunearca) aff. filicata (Guppy)	333
Length 14.8 mm, height 13.0 mm. Locality PJ 285. No. G 12903.	
8,9. Anadara chemnitzoides (Maury)	334
Lectotype. Length 22.0 mm, height 21.4 mm. Locality: milepost 49 $\frac{3}{4}$ (new mileposts!) of the Southern Main Road of Trinidad, just south of the Pitch Lake (= USGS station 21782). Paleont. Museum, Cornell Univ., unnumbered.	
10.11. Anadara (Scapharca ?) sanctidavidis (Maury)	334
Length 27.8 mm, height 21.4 mm. Locality RR 230. No. G 12883.	



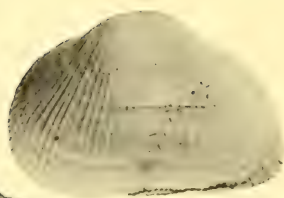
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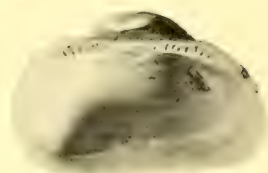
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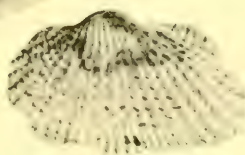
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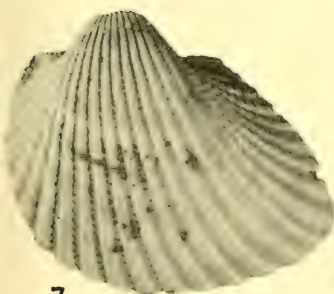
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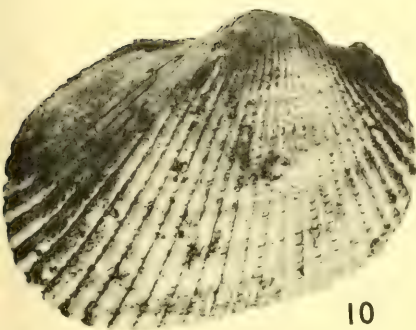
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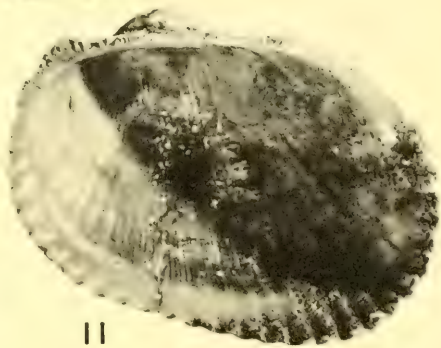
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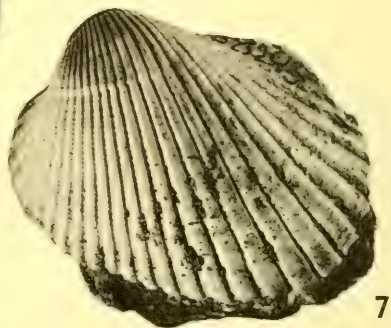
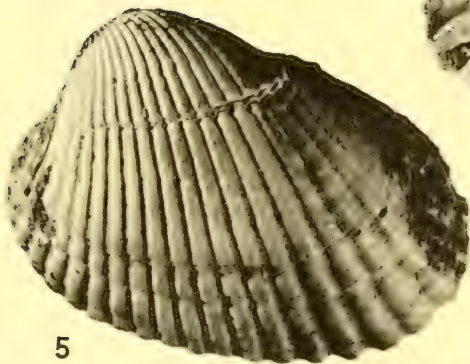
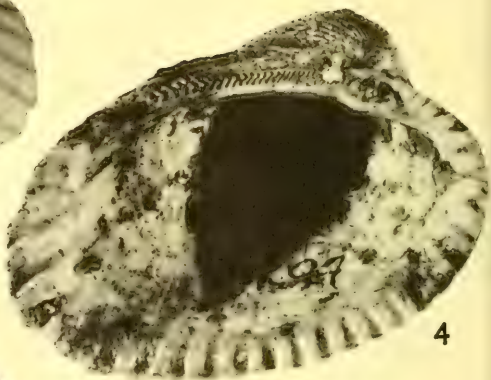
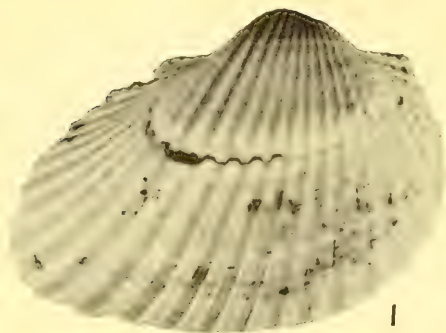
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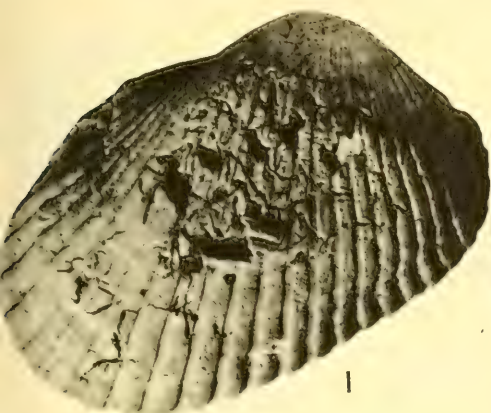


EXPLANATION OF PLATE 16

Figure	Page
1-3. Anadara (Scapharca) placata , n. sp.	335
1,2. Holotype. Length 19.6 mm, height 14.4 mm. Locality KR 11862, No. G 12884. 3. Paratype. Length 19.7 mm, height 14.7 mm. Locality KR 11862, No. G 12885.	
4-7. Lunarca billingsiana (Maury)	336
4,5 Lectotype of <i>L. billingsiana</i> . Length 31.3 mm, height 22.7 mm. Locality: on coast 700 feet east of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 38297. 6,7. Lectotype of <i>L. brightonensis</i> . Length 24.7 mm, height 19.5 mm. Locality: on coast 700 feet east of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 38295.	

EXPLANATION OF PLATE 17

Figure	Page
1-4. Lunarca billingsiana (Maury)	336
1,2. Length 34.8 mm, height 23.1 mm. Locality RR 230. No. G 12910. 3,4. Length 28.6 mm, height 20.3 mm. Locality PJ 212. No. G 12914.	
5-8. Noetia (Noetia) sheldoniana (Maury)	338
5,6. Holotype. Length 15.0 mm, height 13.5 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 38296. 7. Length 33.3 mm, height 27.3 mm. Locality RR 230. No. G 12916. 8. Length 19.8 mm, height 18.9 mm. Locality RR 230. No. G 12917.	



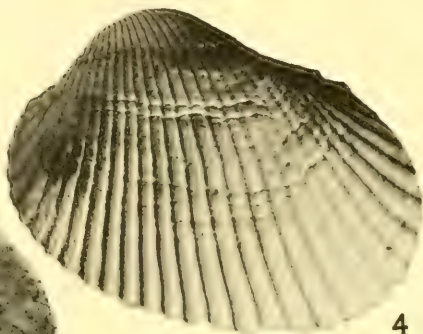
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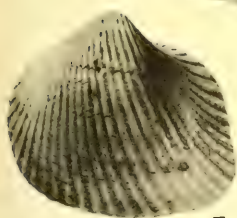
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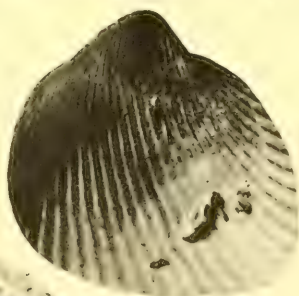
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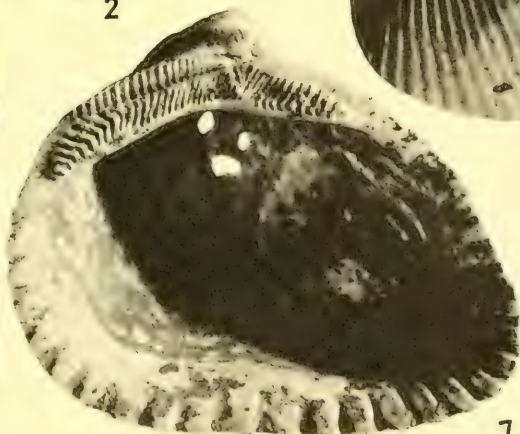
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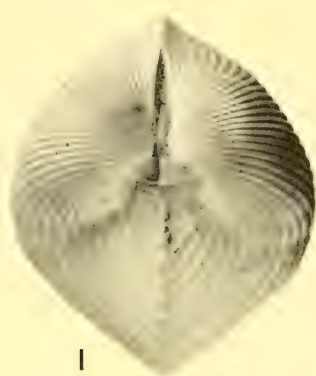
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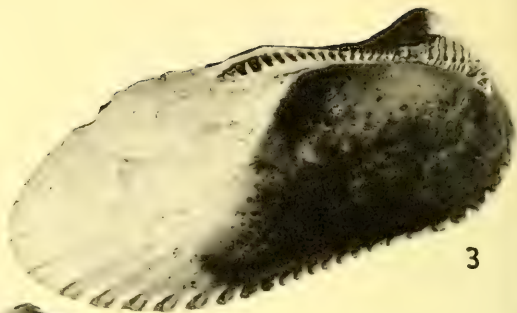
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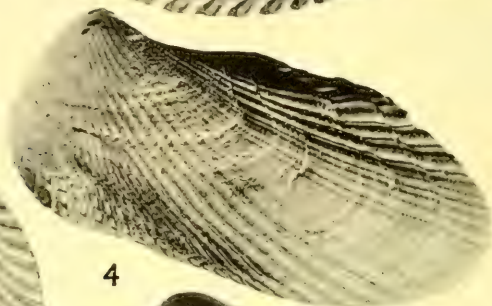
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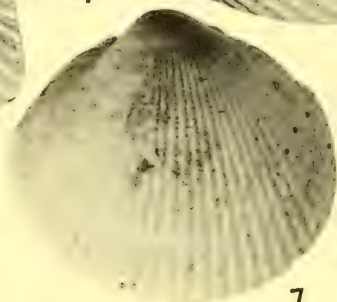
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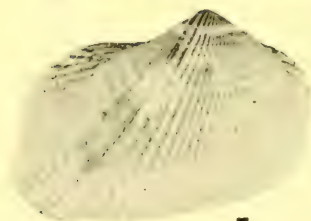
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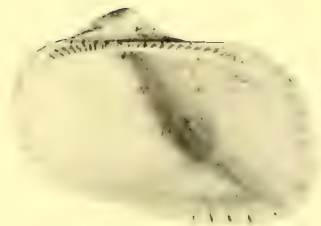
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EXPLANATION OF PLATE 18

Figure	Page
1,2. Noetia (Noetia) sheldoniana (Maury) Length 16.5 mm, height 14.3 mm. Locality PJ 285. No. G 12919.	338
3-6. Noetia (Eontia) centrota (Guppy) 3,4. Length 33.7 mm, height 17.1 mm. Locality RR 230. No. G 12923. 5,6. Length 13.4 mm, height 9.5 mm. Locality K 1429. No. G 12930.	339
7,8. Glycymeris (Glycymeris) cf. undata (Linné) 7. Length 14.9 mm, height 13.3 mm. Locality RR 230. No. G 12935. 8. Length 16.1 mm, height 14.3 mm. Locality RR 230. No. G 12936.	340
9,10. Brachydontes (Brachydontes) species Length 4.1 mm, height 7.0 mm. USGS locality 20432. USNM 645359.	341

EXPLANATION OF PLATE 19

Figure	Page
1,2. Plicatula gibbosa Lamarck	343
Length 15.2 mm, height 16.5 mm. Locality RR 230. No. G 12943.	
3,4. Pecten (Pecten) archon Maury	344
3. Length 43.2 mm, height 40.1 mm. USGS locality 18634. USNM 645326. 4. Length 41.3 mm, height 35.7 mm. USGS locality 18634. USNM 645327.	
5,6. Aequipecten (Plagiectenium) cf. gibbus (Linné)	345
Length 27.0 mm, height 26.7 mm. Locality RR 230. No. G 12949.	



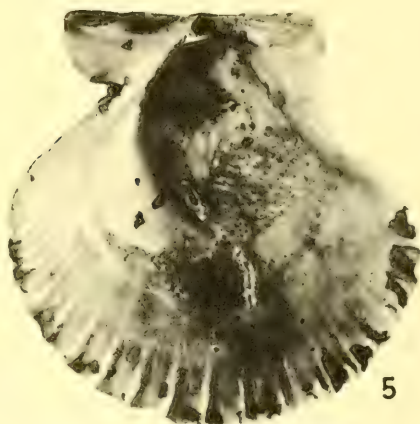
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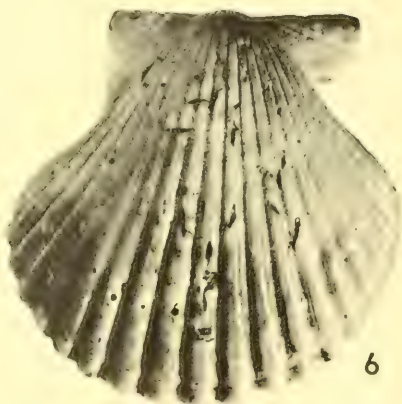
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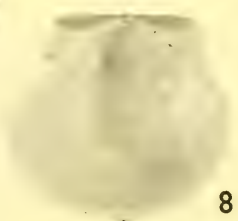
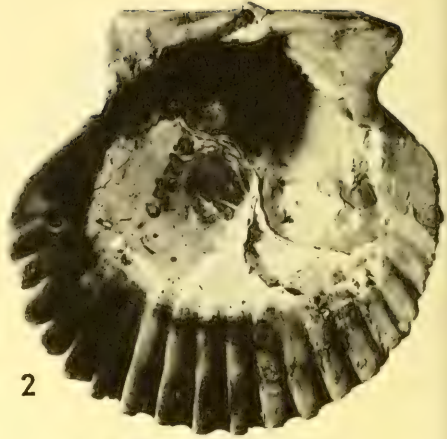
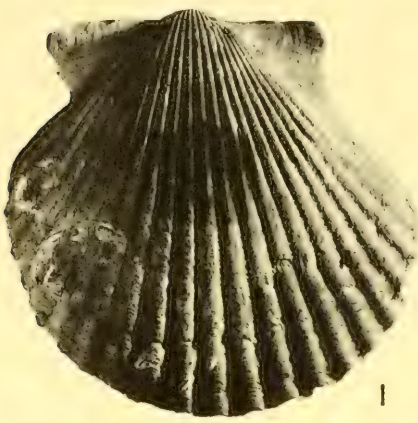
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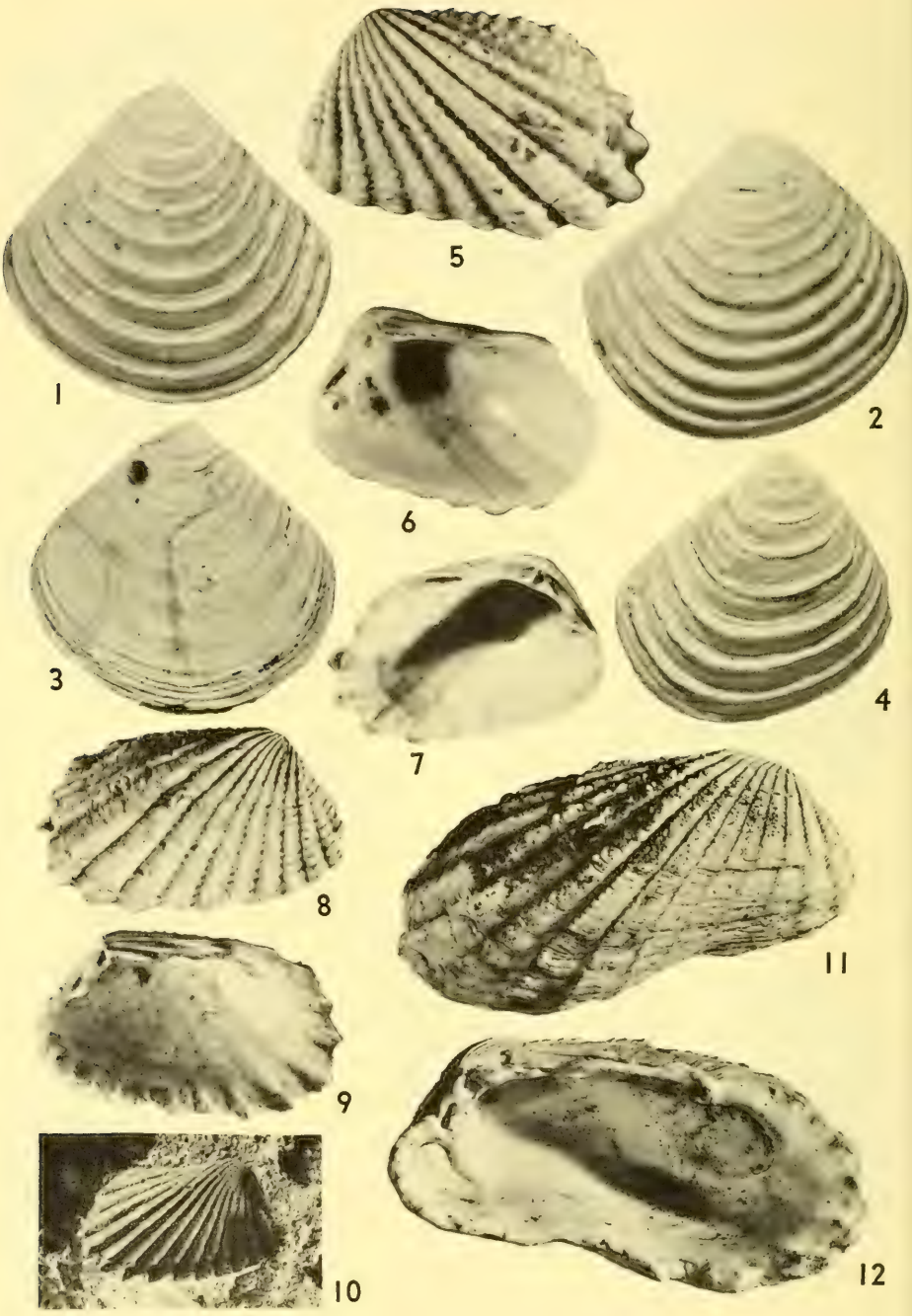
EXPLANATION OF PLATE 20

Figure		Page
1,2.	Aequipecten (Plagiectenium) demiurgus (Dall) Length 55.1 mm, height 53.7 mm. Locality RR 291. No. G 12950.	345
3,4.	Aequipecten (Plagiectenium) maturensis (Maury) 3. Length 24.8 mm, height 22.4 mm, Locality RR 230. No. G 12959. 4. Length 28.5 mm, height 26.0 mm. Locality RR 230. No. G 12960.	346
5,6.	Aequipecten (Plagiectenium) rutamensis , n. sp. 5. Holotype. Length 14.7 mm, height 14.5 mm. Locality RR 230. No. G 12961. 6. Paratype. Length 13.1 mm, height 12.9 mm. Locality RR 230. No. G 12962.	347
7,8.	Cyclopecten species Length 3.0 mm, height 2.8 mm. Locality K 9817, No. G 12966.	348

EXPLANATION OF PLATE 21

Figure	Page
1-4. Eucrassatella trinitaria (Maury)	351
1,2. Length 56.3 mm, height 34.0 mm. USGS locality 18634. USNM 645325. 3,4. Length 19.0 mm, height 12.7. Locality Hutch 51. No. G 13005.	
5. Lopha messor (Maury)	349
Length 54.4 mm. Locality Hutch 51. No. G 12974.	
6. Anomia simplex d'Orbigny	350
Length 16.0 mm, height 15.3 mm. Locality RR 230. No. G 12796.	
7. Crassostrea cf. virginica (Gmelin)	349
Length 84.0 mm. Locality RR 230. No. G 12967.	



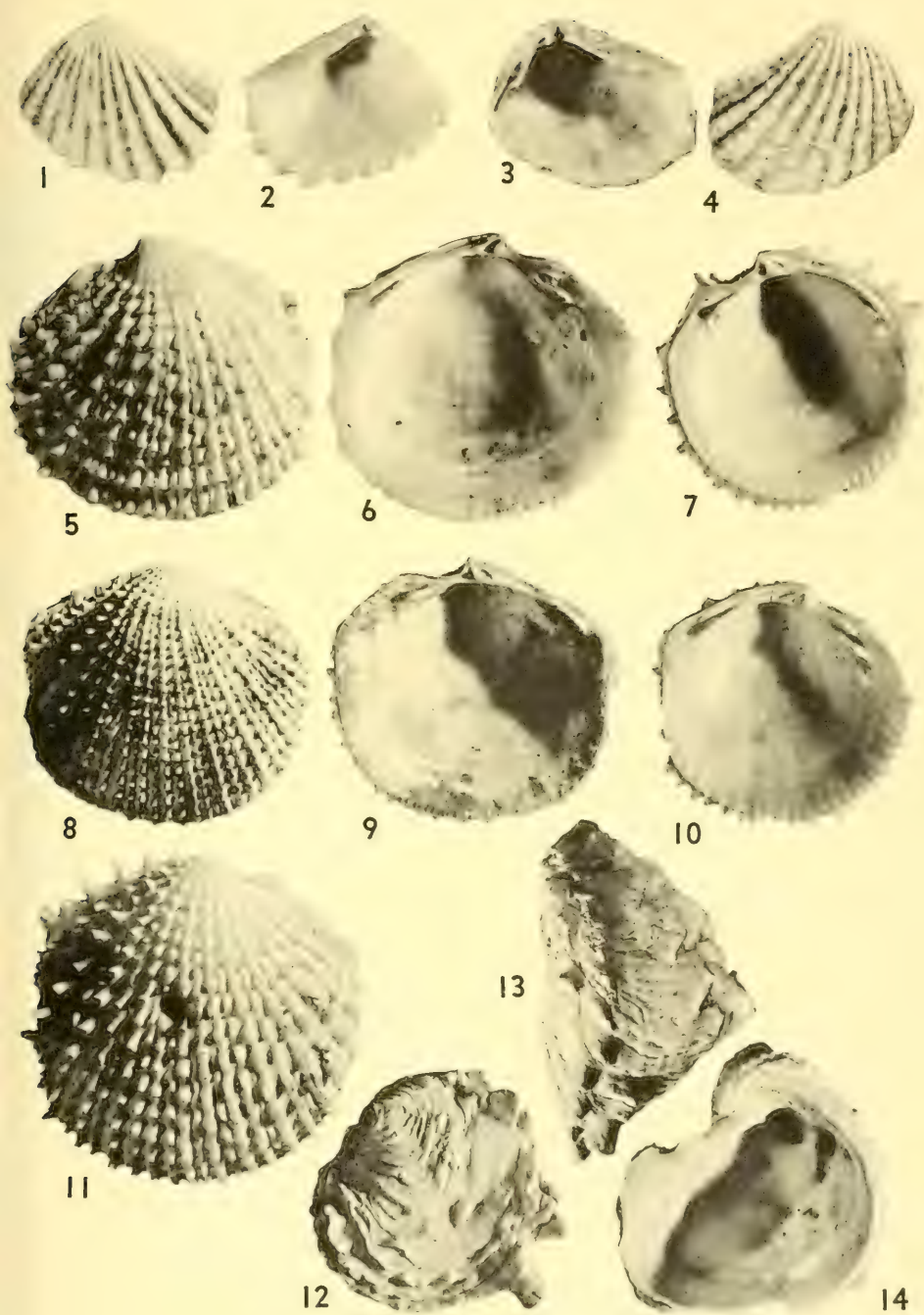


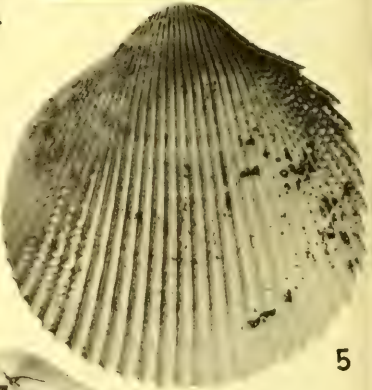
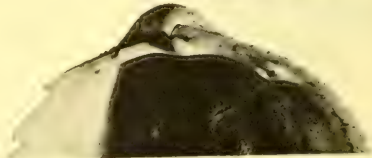
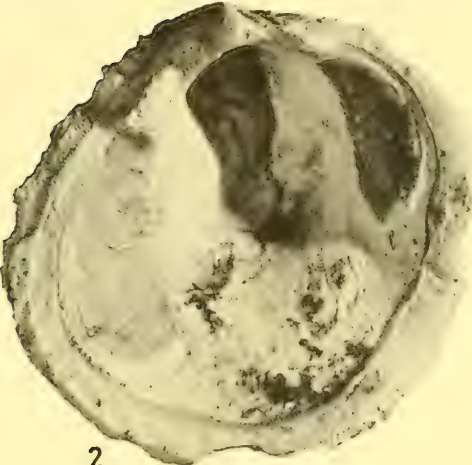
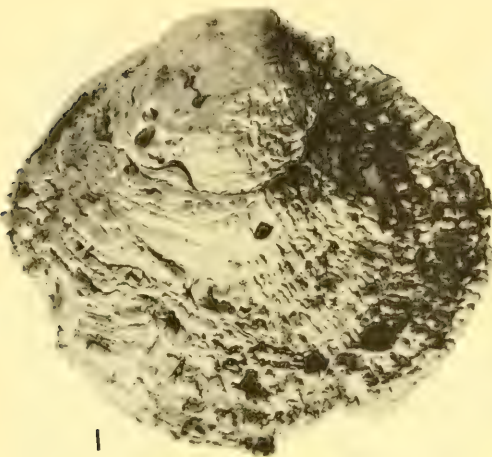
EXPLANATION OF PLATE 22

Figure		Page
1,2.	Crassinella martinicensis (d'Orbigny)	352
	1. Length 4.5 mm, height 4.4 mm. Locality JS 67, No. G 12990.	
	2. Length 4.4 mm, height 4.2 mm. Locality JS 67, No. G 12991.	
3,4.	Crassinella guppyi (Dall)	354
	3. Length 4.2 mm, height 3.9 mm. Locality PJ 285, No. G 12996.	
	4. Length 3.7 mm, height 3.8 mm. Locality PJ 285, No. G 12997.	
5-7.	Carditamera (Carditamera) guppyi (Dall)	356
	5. Length 4.8 mm, height 2.8 mm. Locality JS 67, No. G 13007.	
	6. Length 4.0 mm, height 2.7 mm. Locality RR 230, No. G 13009.	
	7. Length 3.8 mm, height 2.4 mm. Locality K 10924, No. G 13008.	
8,9.	Carditamera (Carditamera) species	357
	Length 8.3 mm, height 4.9 mm. Locality K 9816, No. G 13014.	
10.	Carditamera virginiae (Maury)	357
	Lectotype. Length 13.5 mm, height 7.7 mm. Locality: milepost 49¾ (new mileposts!) of the Southern Main Road of Trinidad, just south of the Pitch Lake (= USGS station 21782). Paleont. Museum, Cornell Univ., unnumbered.	
11,12.	Carditamera (Byssomera) aff. affinis (Sowerby)	357
	Length 32.4 mm, height 15.5 mm. Locality K 8399, No. G 13015.	

EXPLANATION OF PLATE 23

Figure	Page
1-4. Condylocardia guppyi (Maury)	358
1,2. Length 2.8 mm, height 2.1 mm. Locality JS 67. No. G 13016.	
3,4. Length 2.8 mm, height 2.1 mm. Locality RR 230. No. G 13017.	
5-11. Lucina (Lucinisca) roigi (Maury)	360
5,6. Length 11.0 mm, height 9.8 mm. Locality RR 230. No. G 13020.	
7. Length 9.6 mm, height 8.9 mm. Locality PJ 285. No. G 13025.	
8,9. Length 10.2 mm, height 9.4 mm. Locality K 1429. No. G 13024.	
10. Length 9.3 mm, height 8.3 mm. Locality PJ 285. No. G 13026.	
11. Length 12.1 mm, height 11.8 mm. Locality PJ 285. No. G 13027.	
12-14. Pseudochama aff. caloosana (Dall)	362
12. Length 16.4 mm, height 17.5 mm. Locality RR 230. No. G 13046.	
13. Length 19.5 mm, height 23.0 mm. Locality RR 230. No. G 13047.	
14. Length 18.0 mm, height 19.7 mm. Locality RR 230. No. G 13048.	



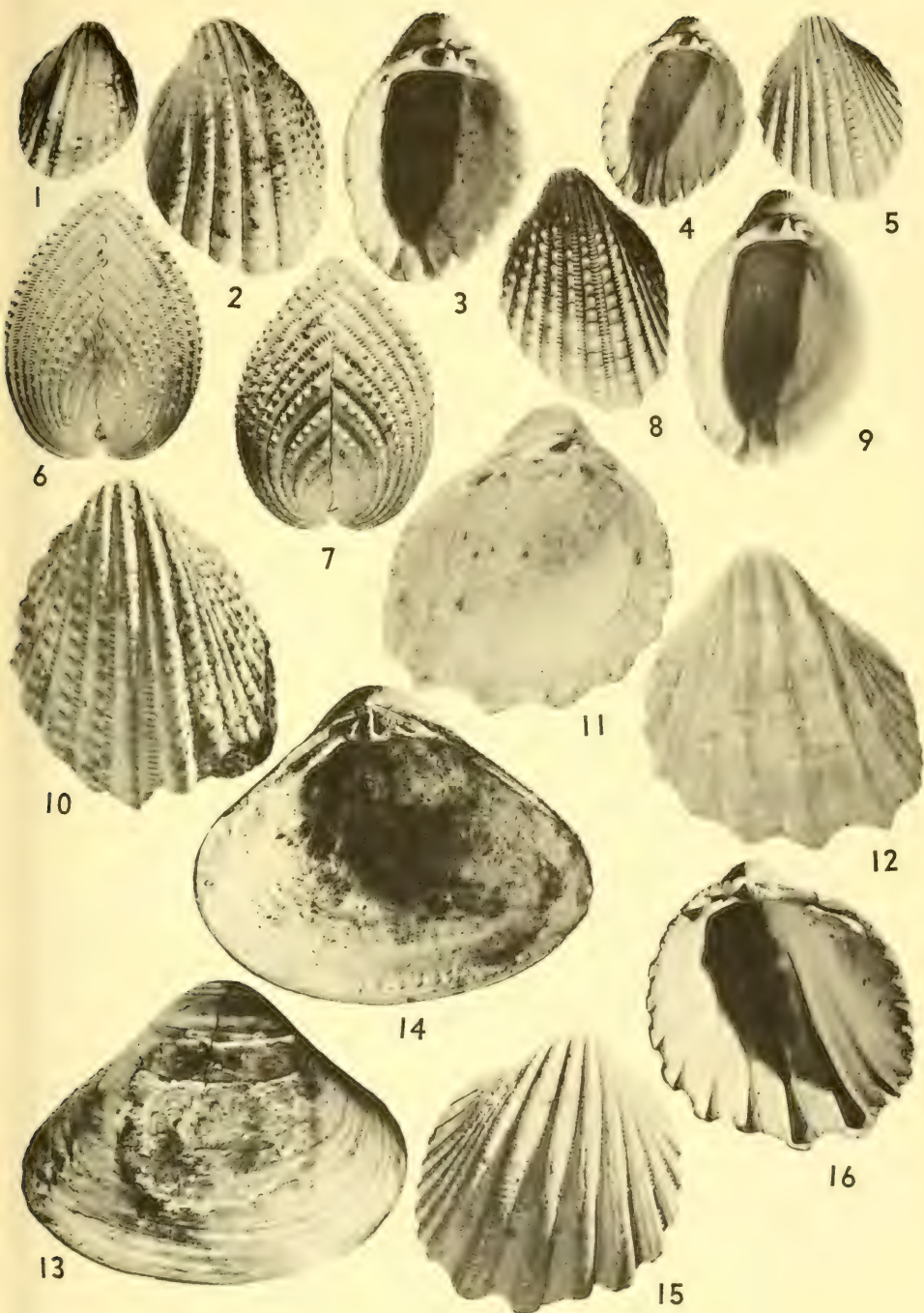


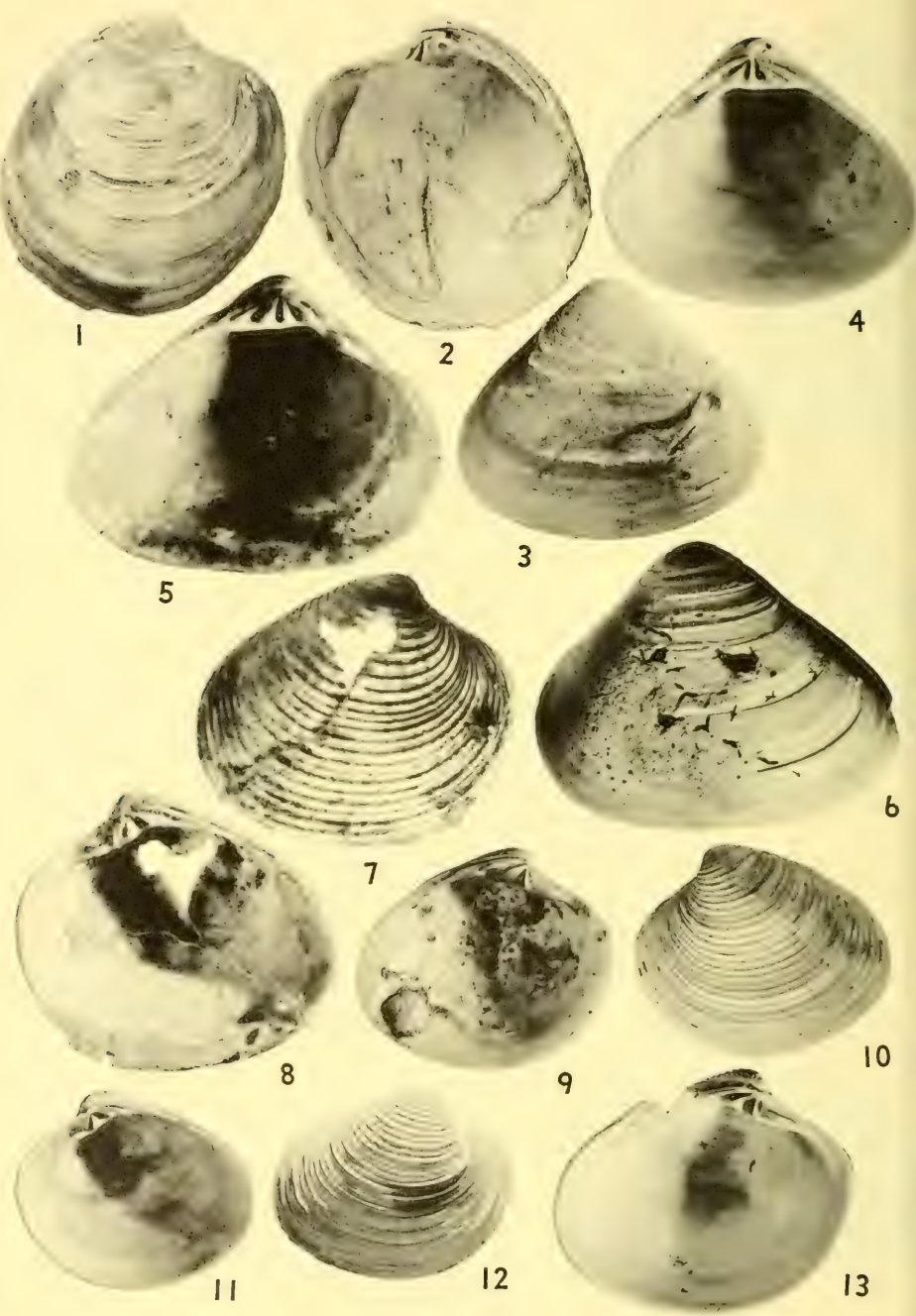
EXPLANATION OF PLATE 24

Figure	Page
1,2. Chama cf. macerophylla Gmelin	362
Length 33.5 mm, height 30.0 mm. Locality PJ 212. No. G 13049.	
3-7. Trachycardium (Dallocardia) sanctidavidis (Maury)	363
3. Length 27.3 mm, height 28.2 mm. Locality RR 230. No. G 13055. 4. Length 25.5 mm, height 26.3 mm. Locality JS 67. No. G 13057. 5. Length 25.2 mm, height 26.5 mm, Locality RR 230. No. G 13056. 6,7. Length 28.9 mm, height 29.6 mm. USGS locality 18411. USNM 645338.	

EXPLANATION OF PLATE 25

Figure	Page
1-10. Trigoniocardia (Trigoniocardia) maturensis (Dall)	365
1. Length 8.8 mm, height 10.4 mm, Locality RR 230. No. G 13061.	
2,3. Length 12.5 mm, height 18.2 mm. Locality RR 230. No. G 13062.	
4,5. Length 10.1 mm, height 12.7 mm. Locality K 1429.	
No. G 13066. 6,7. Convexity (2 valves) 13.8 mm, height 19.1 mm.	
Locality PJ 285. No. G 13063. 8. Length 11.7 mm, height 17.3 mm.	
Locality PJ 285. No. G 13064. 9. Length 12.6 mm, height 18.7 mm.	
Locality KR 11862. No. G 13065. 10. Lectotype of <i>T. carolinae</i> (Maury).	
Length 8.7 mm, height 11.4 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered.	
11,12. Trigoniocardia (Trigoniocardia) melajoensis , n. sp.	366
Holotype. Length 10.0 mm, height 10.6 mm. USGS locality 18411. USNM 645354.	
13,14. Tivela (Tivela) austeniana (Maury)	372
Lectotype. Length 27.0 mm, height 21.3 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered.	
15,16. Trigoniocardia (Trigoniocardia) cf. caboblanquensis Weisbord	367
Length 9.7 mm, height 10.0 mm. Locality RR 120. No. G 13077.	



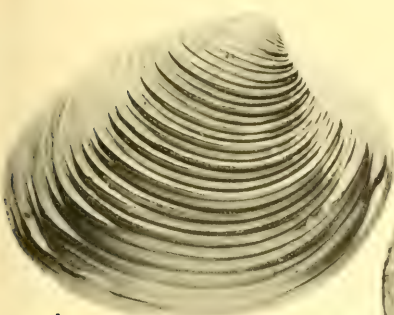


EXPLANATION OF PLATE 26

Figure	Page
1,2. Cyclinella aff. tenuis (Recluz)	372
Length 24.2 mm, height 23.1 mm. USGS locality 20432a. USNM 645339.	
3-6. Tivela (Tivela) austeniana (Maury)	372
3,4. Length 21.0 mm, height 17.6 mm. Locality RR 230. No. G 13086. 5,6. Length 25.0 mm, height 19.8 mm. Locality RR 230. No. G 13085.	
7-13. Pitar (Lamelliconcha) circinatus (Born)	374
7,8. Specimen figured by Maury (1912, pl. 9, figs. 12, 13). Length 10.7 mm, height 9.6 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered. 9,10. Length 17.2 mm, height 14.2 mm. Locality RR 230. No. G 13092. 11,12. Length 16.1 mm, height 13.2 mm. Locality K 1429. No. G 13098. 13. Length 20.1 mm, height 16.3 mm. Locality Hutch 51. No. G 13099.	

EXPLANATION OF PLATE 27

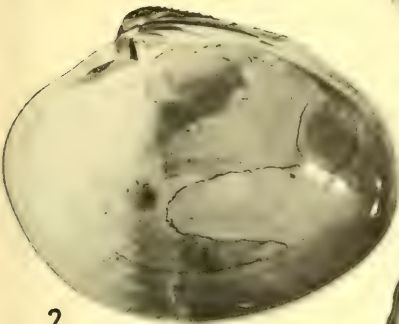
Figure	Page
1,2. Pitar (Lamelliconcha) circinatus (Born)	374
Length 26.2 mm, height 20.5 mm. Locality Hutch 47. No. G 13100.	
3-6. Pitar (Lamelliconcha) labreanus (Maury)	375
3,4. Holotype. Length 17.3 mm, height 13.5 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered. 5,6. Length 24.8 mm, height 18.5 mm. Locality Hutch 51. No. G 13250.	
7. Chione (Chione) cancellata (Linné)	376
Length 31.7 mm, height 30.1 mm. Locality RR 230. No. G 13258.	



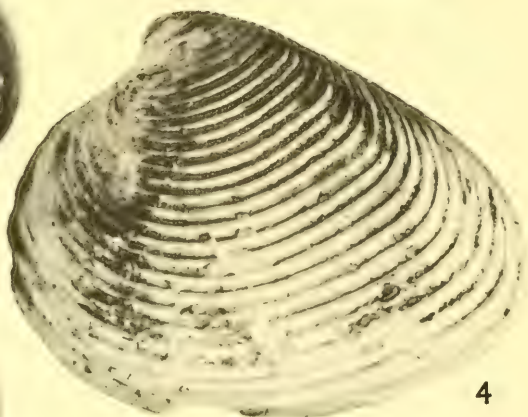
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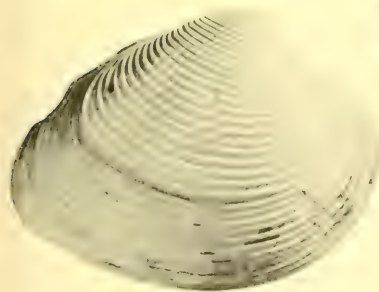
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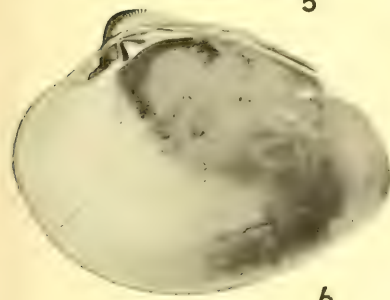
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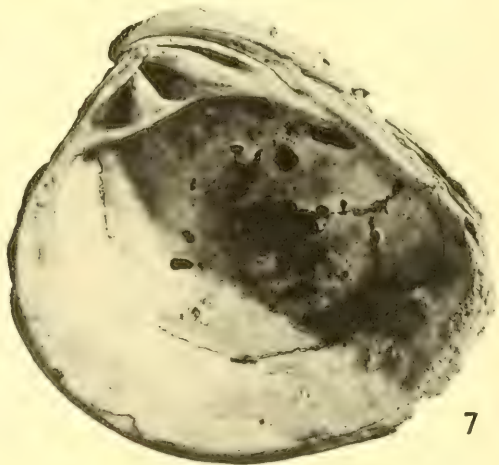
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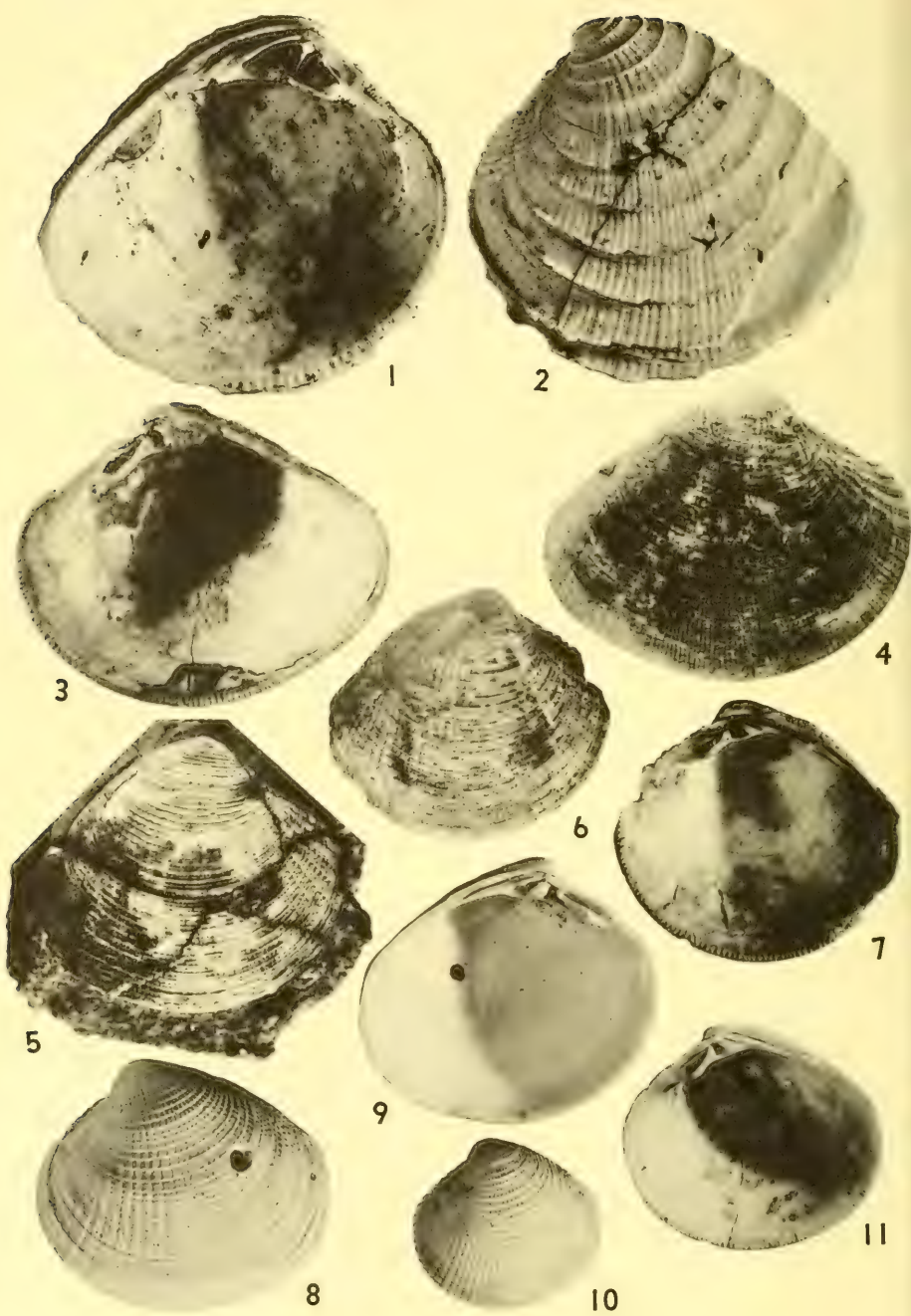
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EXPLANATION OF PLATE 28

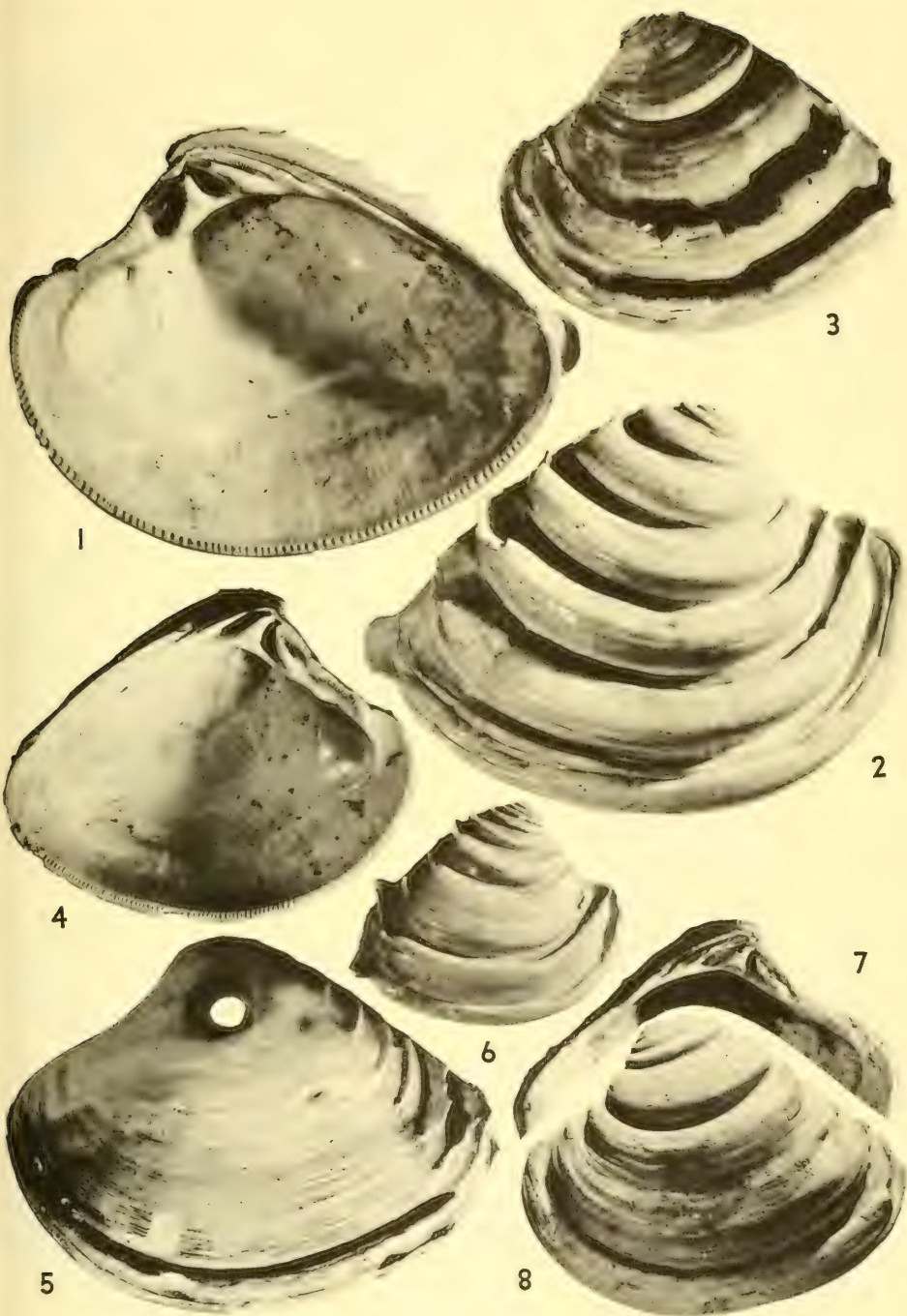
Figure	Page
1,2. Chione (Chione) cancellata (Linné)	376
Length 27.2 mm, height 24.8 mm. Locality RR 230. No. G 13257.	
3-11. Chione (Nioche) veatchiana Maury	377
3,4. Lectotype of <i>C. veatchiana</i> . Length 25.1 mm, height 20.2 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 33504.	
5. Lectotype of <i>C. dalliana</i> . Length 20.5 mm, height 18.0 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 33495.	
6,7. Lectotype of <i>C. guppyana</i> . Length 19.1 mm, height 17.2 mm. Locality: on coast 700 feet east of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered.	
8,9. Length 20.0 mm, height 17.3 mm. Locality RR 230. No. G 12769.	
10. Length 12.6 mm, height 11.5 mm. Locality K 12255. No. G 12792.	
11. Length 17.0 mm, height 15.0 mm. Locality JS 67. No. G 12788.	

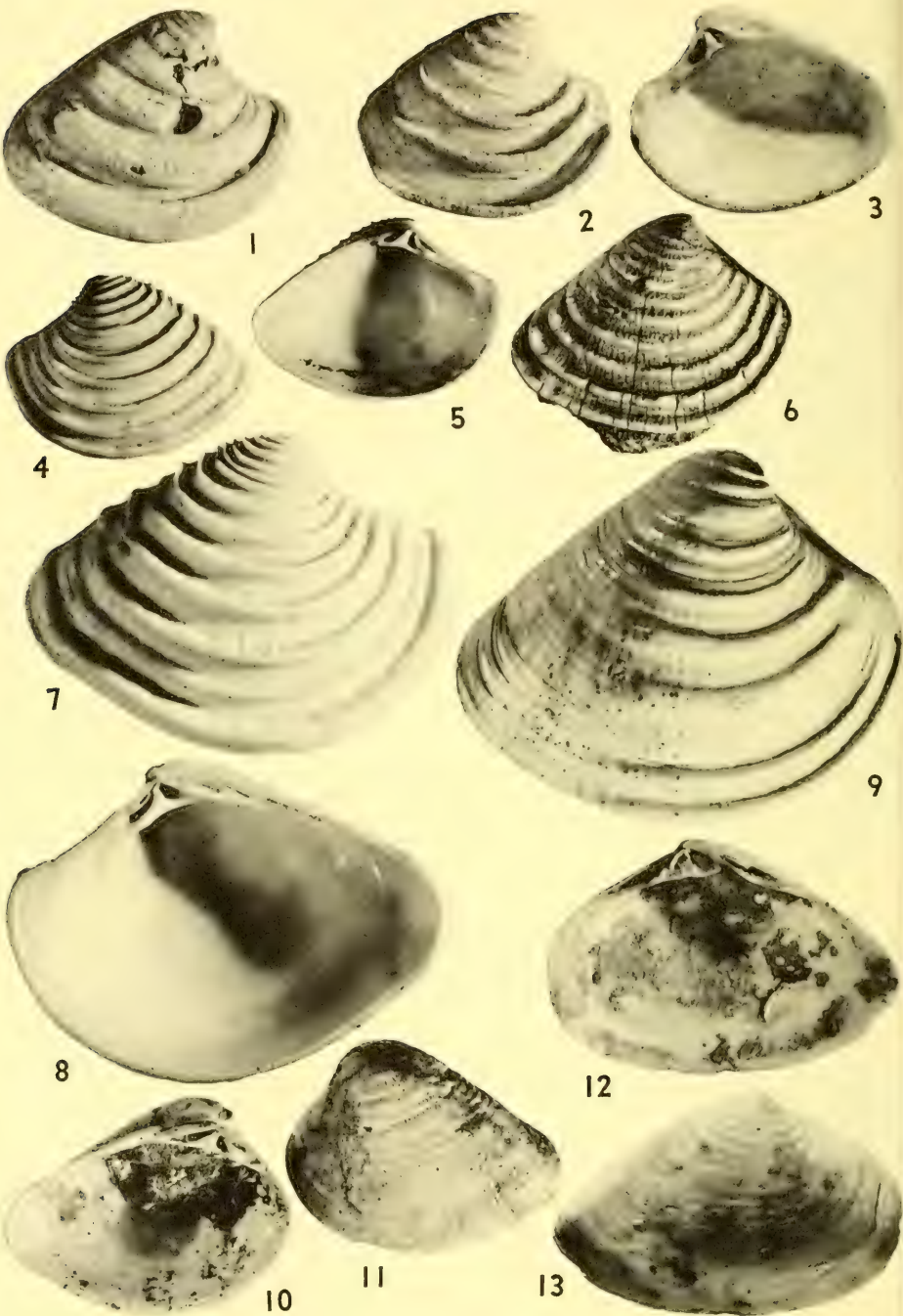
EXPLANATION OF PLATE 29

Figure

Page

- 1-8. **Chione (Lirophora) caroniana** Maury 379
 1,2. Length 39.0 mm, height 29.1 mm. Locality EL 1810. No. G 13265. 3,4. Length 27.9 mm, height 22.6 mm. Locality Hutch 51. No. G 13266. 5. Length 34.3 mm, height 26.2 mm. Locality RR 291. No. G 13277. 6. Length 18.2 mm, height 15.0 mm. Locality PJ 285. No. G 13267. 7,8. Length 26.3 mm, height 21.1 mm. Locality RR 291. No. G 13276.



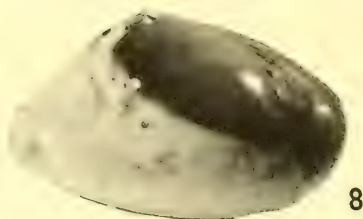
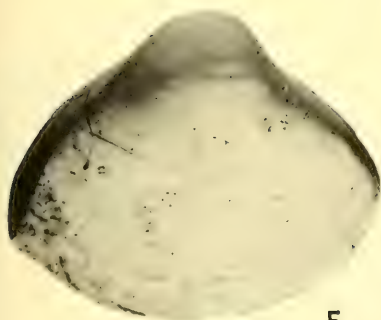
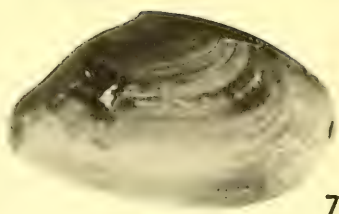
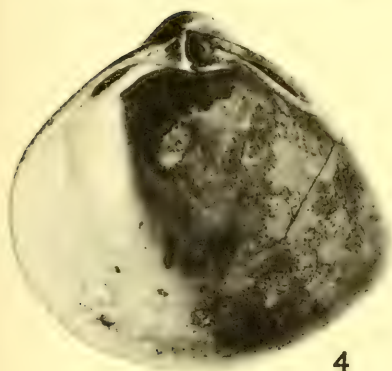
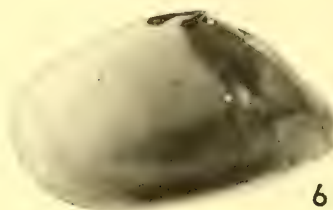
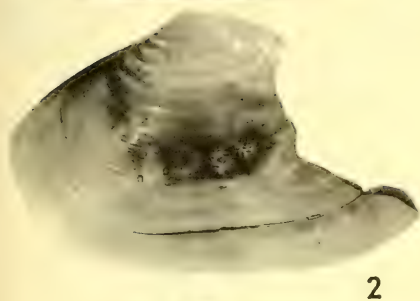
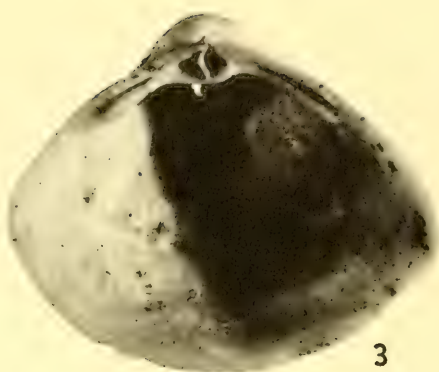
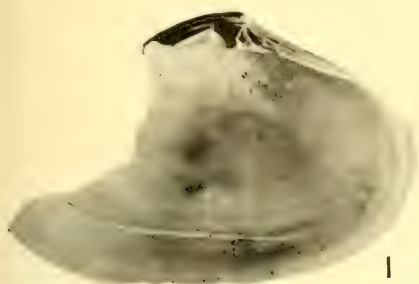


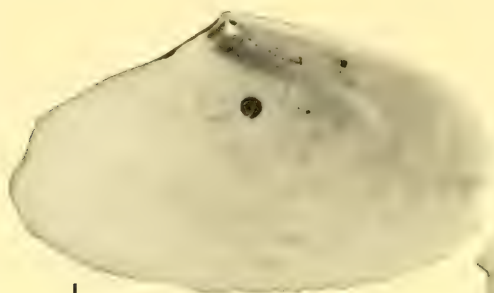
EXPLANATION OF PLATE 30

Figure	Page
1-3. Chione (Lirophora) species	380
1. Length 20.0 mm, height 15.6 mm. Locality JS 67. No. G 13263.	
2,3. Length 17.6 mm, height 13.8 mm. Locality RR 230. No. G 13264.	
4-9. Chione (Lirophora) sanctidavidis Maury	381
4,5. Length 17.0 mm, height 12.4 mm. Locality K 12255. No. G 12794.	
6. Length 19.5 mm, height 15.0 mm. Locality RR 230. No. G 13278.	
7,8. Length 15.7 mm, height 11.6 mm. Locality K 12255. No. G 12814.	
9. Length 16.1 mm, height 13.2 mm. Locality K 9813. No. G 13279.	
10,11. Anomalocardia brasiliana (Gmelin)	382
Length 19.2 mm, height 15.0 mm, Locality JS 67. No. G 13081.	
12,13. Mactra (Micromactra) cf. maracaibensis H. K. Hodson	383
Length 23.9 mm, height 15.7 mm. Locality RR 230. No. G 13288.	

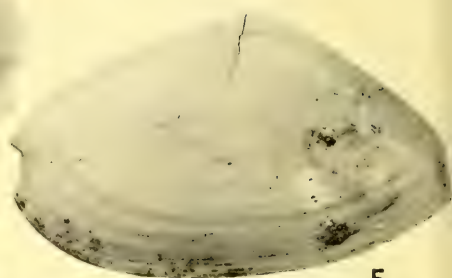
EXPLANATION OF PLATE 31

Figure	Page
1,2. Mactra (Micromactra) cf. maracaibensis H. K. Hodson	383
Length 26.7 mm, height 17.6 mm. Locality EL 1810. No. G 13289.	
3-5. Mulinia species	383
3. Length 14.5 mm, height 12.2 mm. Locality RR 230. No. G 13286. 4. Length 25.3 mm, height 23.4 mm. Locality RR 230. No. G 13285. 5. Length 13.0 mm, height 11.0 mm. Locality RR 230. No. G 13287.	
6-9. Moerella (Moerella) elinguis , n. sp.	384
6,7. Holotype. Length 10.8 mm, height 6.3 mm. Locality KR 11862. No. G 13327. 8. Paratype. Length 10.9 mm, height 6.8 mm. Locality KR 11862. No. G 13328. 9. Paratype. Length 13.4 mm, height 8.0 mm. Locality K 12255. No. G 13329.	





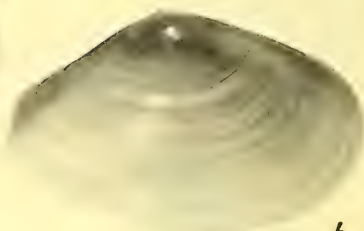
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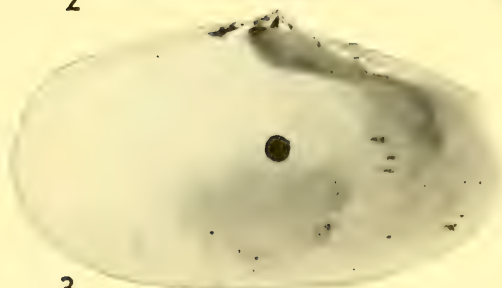
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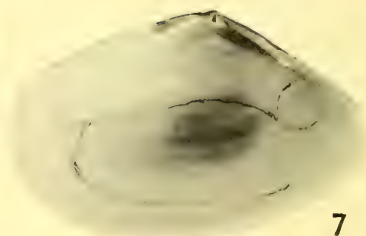
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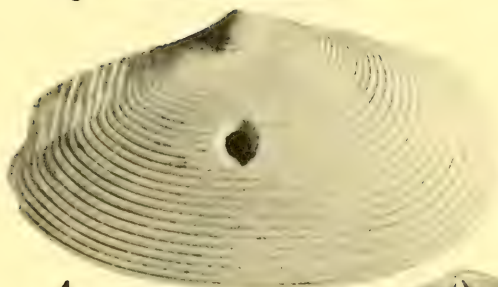
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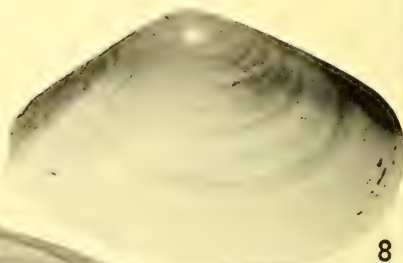
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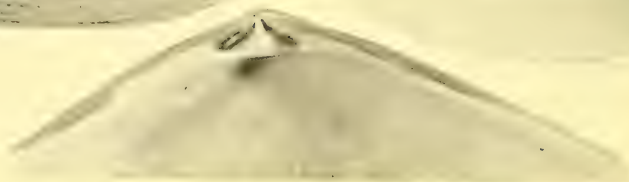
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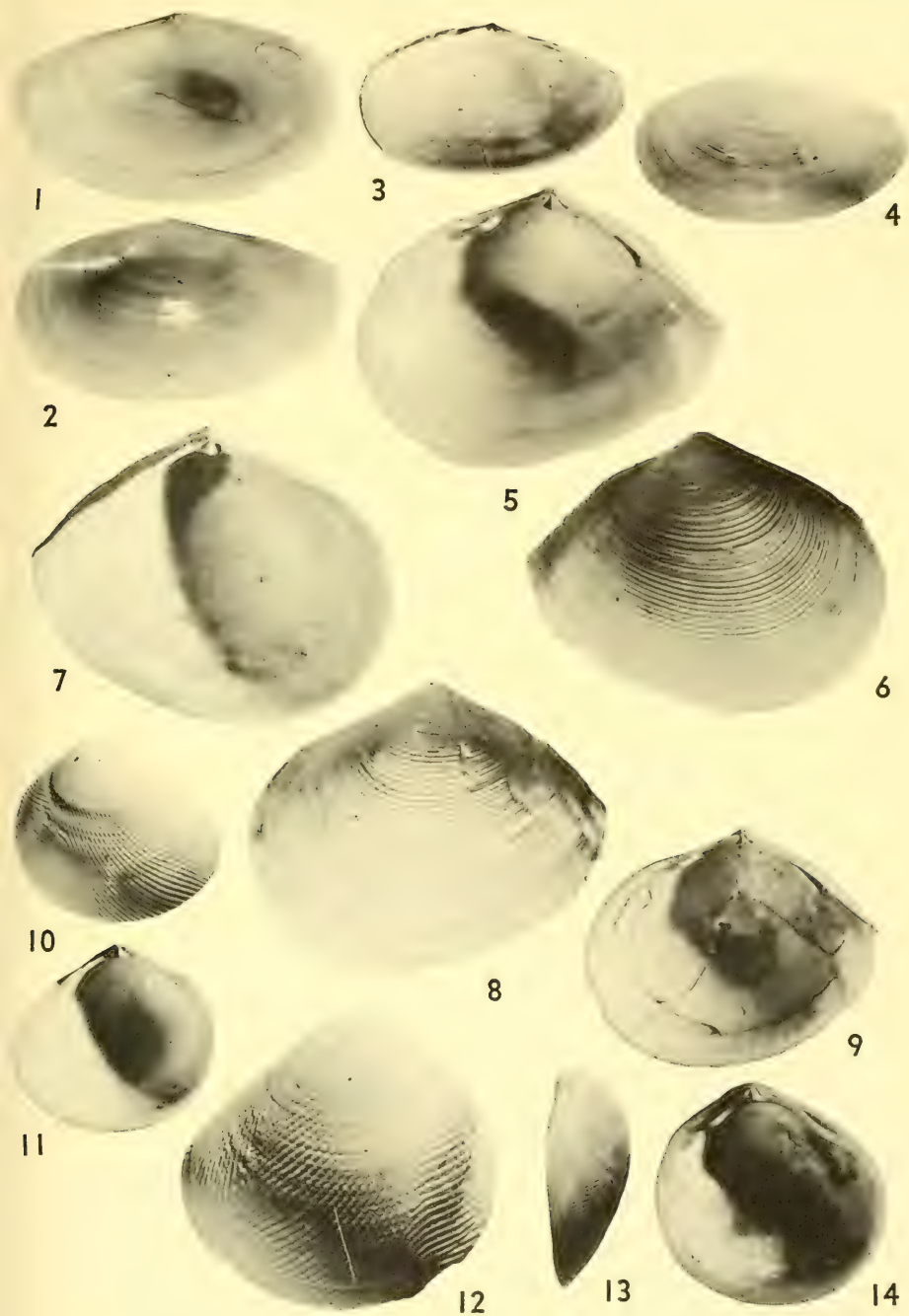
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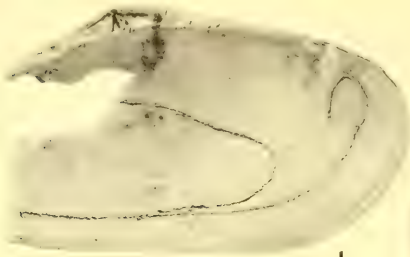
EXPLANATION OF PLATE 32

Figure	Page
1-5. Eurytellina punicea (Born) ?	385
1,2. Immature specimen. Length 16.2 mm, height 9.3 mm. Locality K 12255. No. G 12845. 3,4. Immature specimen. Length 16.7 mm, height 9.5 mm. Locality K 12013. No. G 12850. 5. Length 34.4 mm, height 21.0 mm. USGS locality 20432. USNM 645337.	
6-9. Eurytellina melajoensis . n. sp.	386
6,7. Holotype. Length 23.8 mm, height 15.0 mm. Locality PJ 285. No. G 13310. 8. Paratype. Length 26.3 mm, height 17.1 mm. Locality PJ 285. No. G 13312. 9. Paratype. Hinge. 7.5x. No. G 13311.	

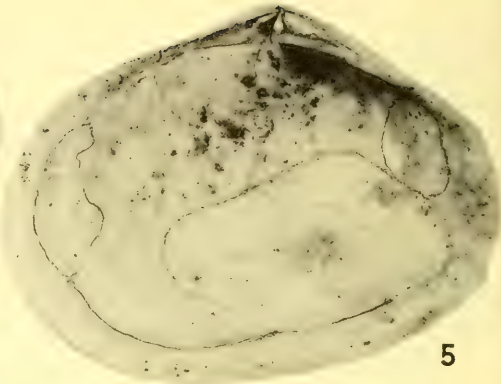
EXPLANATION OF PLATE 33

Figure		Page
1-4.	Eurytellina ? oligoscissulata , n. sp.	386
	1,2. Holotype. Length 22.0 mm, height 12.4 mm. Locality PJ 285. No. G 13319. 3. Paratype. Length 17.5 mm, height 10.0 mm. Locality PJ 285. No. G 13320. 4. Paratype. Length 18.0 mm, height 10.2 mm. Locality K 1429. No. G 13321.	
5-9.	Merisca trinidadensis , n. sp.	387
	5,6. Holotype. Length 12.1 mm, height 9.2 mm. Locality Hutch 51. No. G 13338. 7,8. Paratype. Length 12.3 mm, height 10.0 mm. Locality RR 290. No. G 13340. 9. Paratype. Length 10.0 mm, height 7.7 mm. Locality PJ 285. No. G 13339.	
10,11.	Strigilla (Strigilla) carnaria (Linné) ?	389
	Length 7.4 mm, height 6.7 mm. Locality K 12255. No. G 12795.	
12-14.	Strigilla (Pisostrigilla) pisiformis (Linné)	390
	12. Length 11.3 mm, height 10.7 mm. Locality RR 230. No. G 13343. 13,14. Length 8.2 mm, height 7.8 mm. Locality RR 230. No. G 13344.	

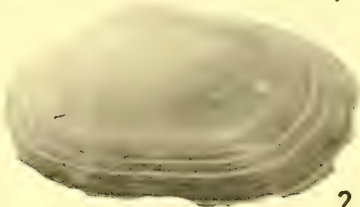




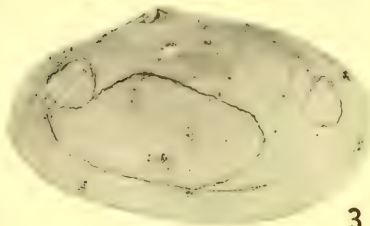
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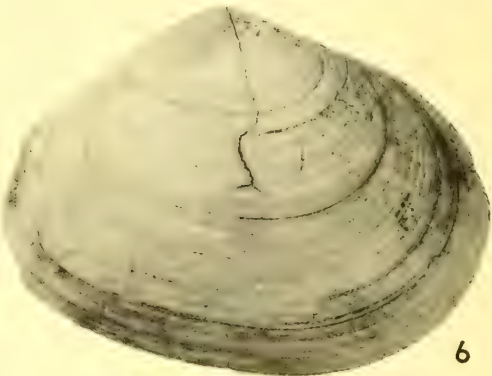
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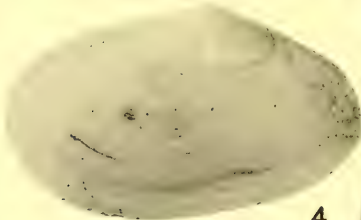
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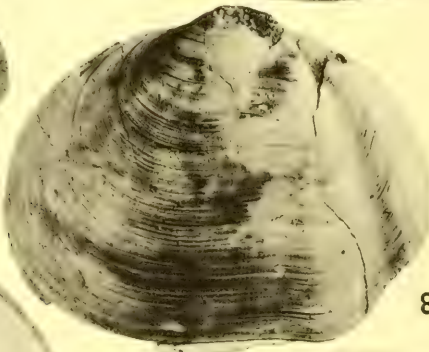
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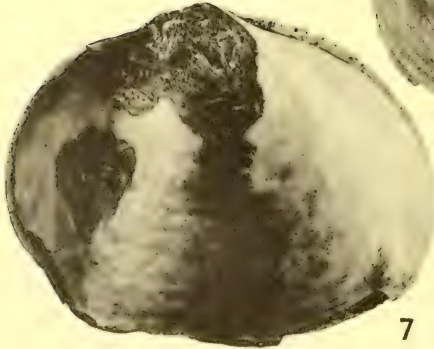
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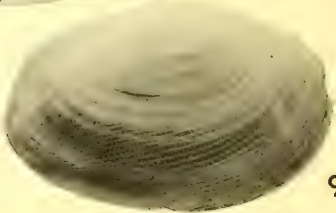
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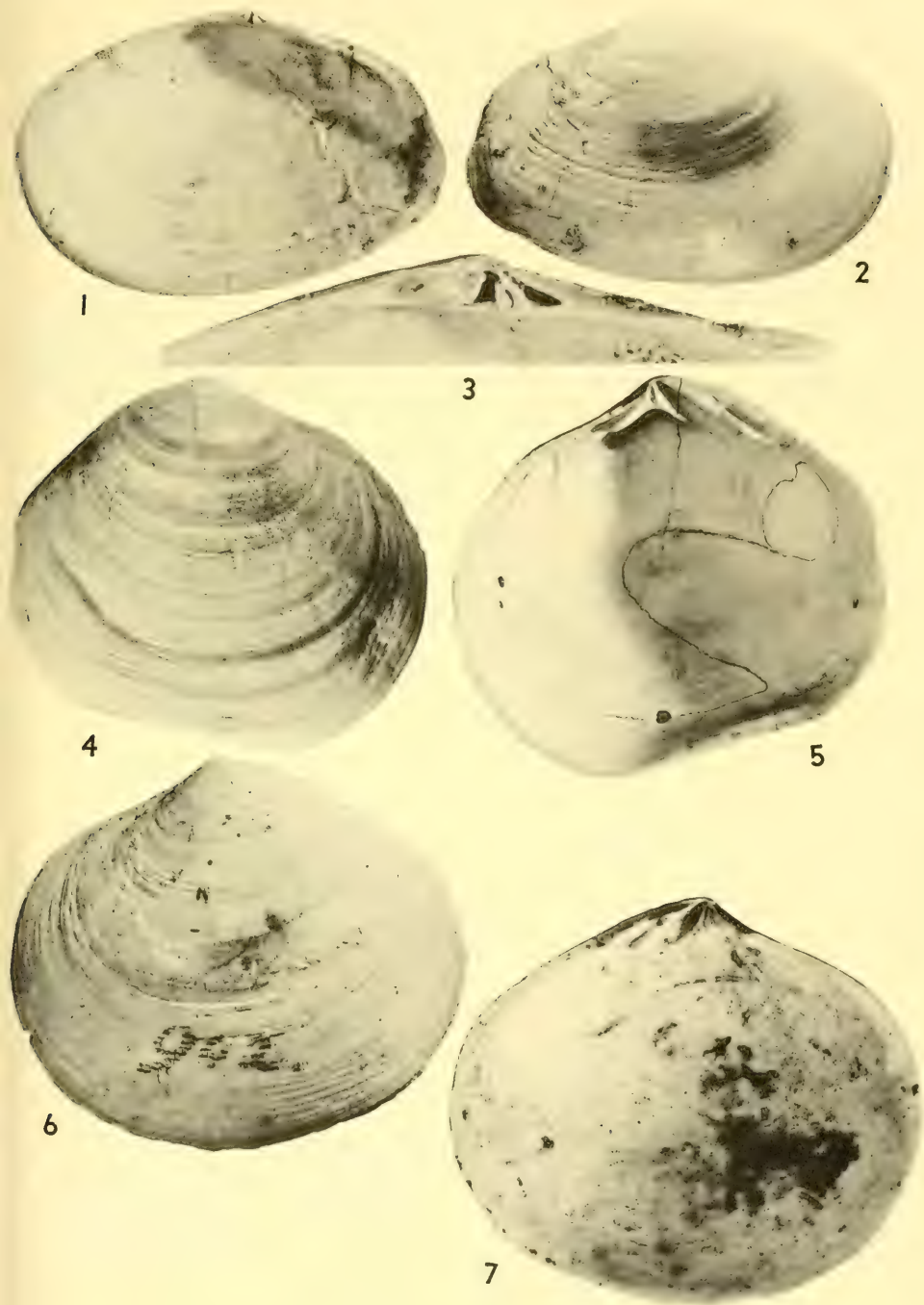
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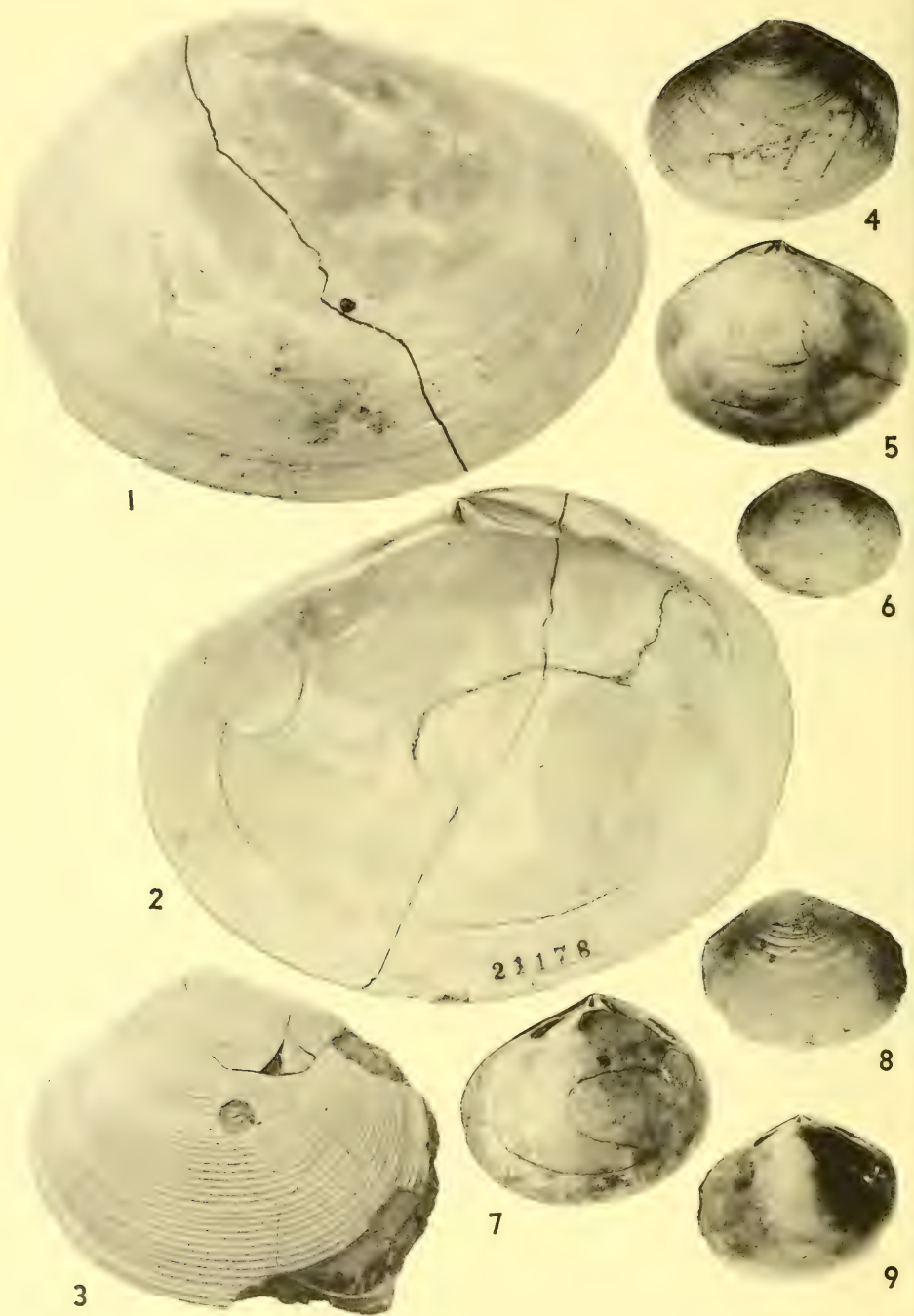
EXPLANATION OF PLATE 34

Figure	Page
1,2. Macoma (Psammacoma) species A	391
1. Length 30.7 mm, height 19.2 mm. USGS locality 18411. USNM 645340. 2. Length 27.5 mm, height 15.7 mm. USGS locality 18634. USNM 645341.	
3,4. Macoma (Psammacoma) species B	392
Length 27.9 mm, height 17.0 mm. USGS locality 20432. USNM 645342.	
5,6. Psammotreta galbana , n. sp.	392
Holotype. Length 37.8 mm, height 28.2 mm. USGS locality 20432. USNM 645335.	
7,8. Apolymetis trinitaria (Dall)	393
Length 57.1 mm, height 46.2 mm. Locality RR 291. No. G 13347.	
9. Temnoconcha aff. brasiliiana (Dall)	395
Length 22.0 mm, height 14.4 mm. Locality EL 1810. No. G 13307.	

EXPLANATION OF PLATE 35

Figure	Page
1-3. Temnoconcha aff. brasiliانا (Dall)	395
1,2. Length 29.6 mm, height 19.4 mm. Locality PJ 212. No. G 13308. 3. Hinge of same specimen as figures 1 and 2; 7.5x.	
4,5. Semele proficua (Pulteney)	396
Length 29.2 mm, height 25.0 mm. Locality RR 230. No. G 13299.	
6,7. Semele purpurascens (Gmelin)	396
Length 31.3 mm, height 27.3 mm. Locality RR 230. No. G 13298.	





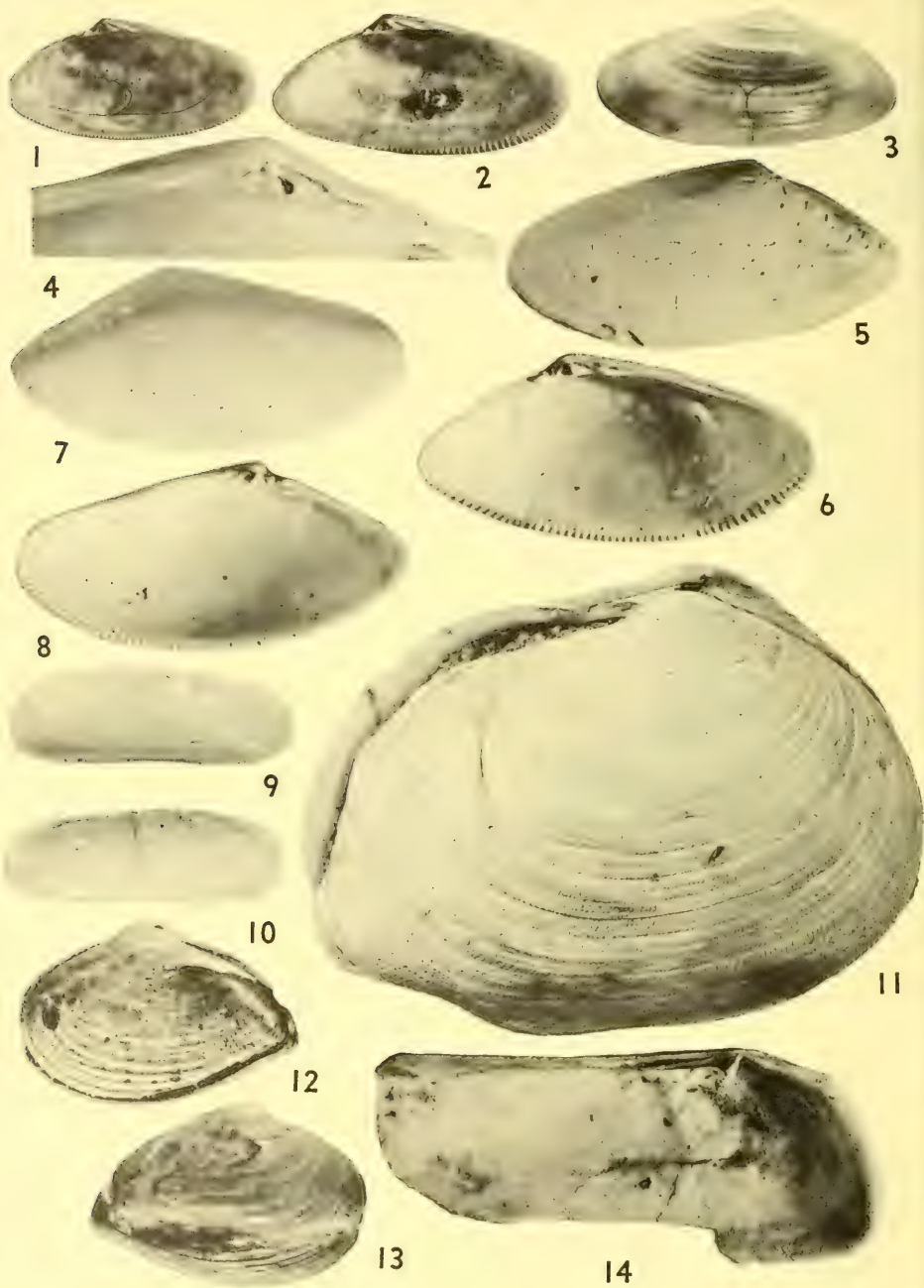
EXPLANATION OF PLATE 36

Figure	Page
1,2. Semele laevis costaricensis Olsson	397
Length 61.4 mm, height 46.6 mm. USGS locality 21178. USNM 645324.	
3. Semele claytoni couvensis Maury	398
Length 37.7 mm, height 32.9 mm. USGS locality 18411. USNM 645329.	
4-9. Semele aff. anteriocosta Vokes	398
4,5. Length 17.4 mm, height 14.1 mm. Locality RR 230. No. G 13303. 6. Length 11.2 mm, height 8.9 mm. Locality K 1429. No. G 12842. 7. Length 17.0 mm, height 14.2 mm. Locality RR 230. No. G 13302. 8,9. Length 14.0 mm, height 11.3 mm. Locality KR 11862. No. G 13301.	

EXPLANATION OF PLATE 37

Figure	Page
1-3. <i>Abra</i> cf. <i>aequalis</i> (Say)	399
1. Length 9.7 mm, height 9.0 mm. Locality K 8399, No. G 12849.	
2,3. Length 10.0 mm, height 9.6 mm. Locality K 1429, No. G 13306.	
4-6. <i>Cumingia</i> <i>galbensis</i>, n. sp.	400
4,5. Holotype. Length 13.5 mm, height 11.4 mm. USGS locality 20432. USNM 645355.	
6. Paratype. Length 13.2 mm, height 10.7 mm. USGS locality 20432. USNM 645356.	
7,8. <i>Donax</i> <i>striatus</i> Linné ?	401
Length 20.2 mm, height 12.6 mm. Locality RR 230, No. G 14055.	
9. <i>Donax</i> <i>fabagelloides</i> Guppy	402
Holotype. Length 20.5 mm, height 9.7 mm. Matura, coll. Guppy, USNM 115654.	
10,11. <i>Donax</i> (<i>Machaerodonax</i> ?) species	404
Length 16.6 mm. USGS locality 19860. USNM 645349.	



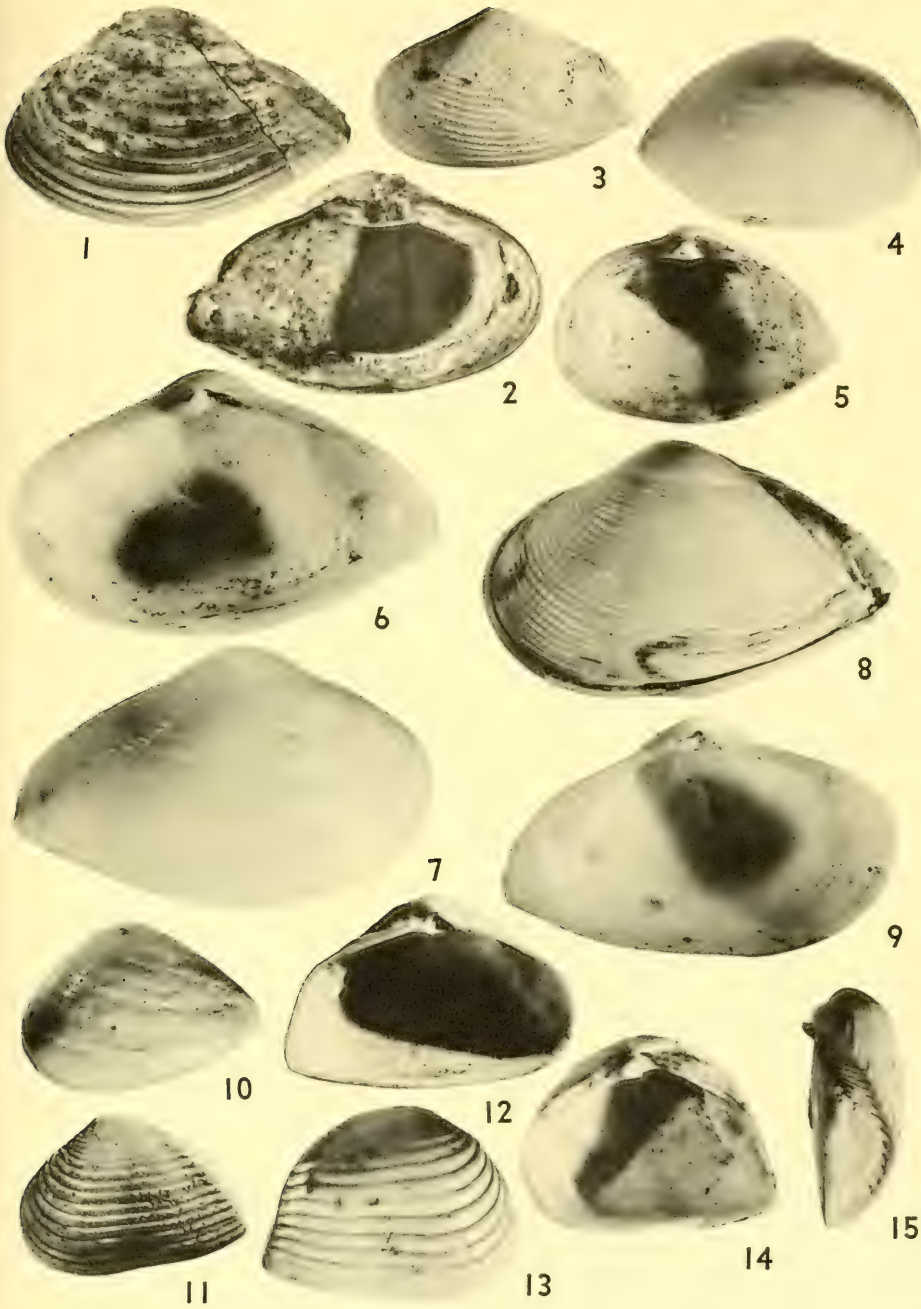


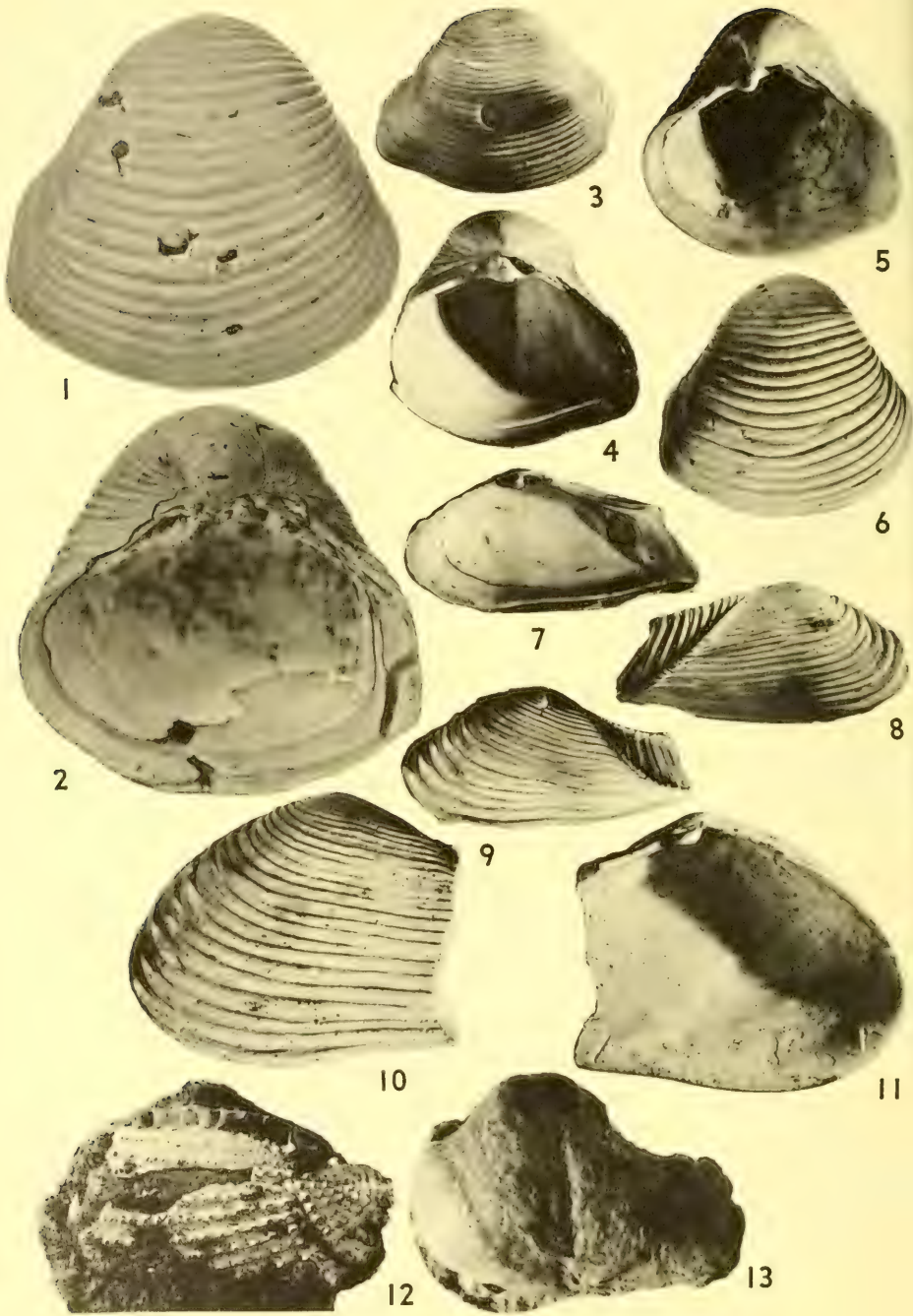
EXPLANATION OF PLATE 38

Figure	Page
1-4. Donax fabagelloides Guppy	402
1. Length 16.3 mm, height 8.1 mm. Locality JS 67. No. G 13291.	
2. Length 20.0 mm, height 9.1 mm. Locality RR 230. No. G 13292.	
3. Length 20.1 mm, height 9.2 mm. Locality RR 230. No. G 13294.	
4. Hinge. 7.5x. Locality RR 230. No. G 13293.	
5-8. Donax brightonensis , n. sp.	403
5,6. Holotype. Length 13.2 mm, height 6.1 mm. Locality RR 120. No. G 12861.	
7,8. Paratype. Length 13.3 mm, height 6.3 mm. Locality K 12255. No. G 12855.	
9,10. Tagelus (Mesopleura) cf. divisus (Spengler)	405
Length 22.8 mm, height 8.0 mm. USGS locality 20434. USNM 645336.	
11. Pleiorytis caroniana (Maury)	406
Length 57.8 mm, height 45.6 mm. USGS locality 18634. USNM 645323.	
12,13. Caryocorbula (Caryocorbula) helenae (Maury)	407
Lectotype. Length 7.3 mm, height 5.0 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 33497.	
14. Solen (Solena) obliquus Spengler	407
Length 34.6 mm, height 14.2 mm. Locality JS 67. No. G 14002.	

EXPLANATION OF PLATE 39

Figure	Page
1-5. Caryocorbula (Caryocorbula) helenae (Maury)	407
1,2. Lectotype of <i>C. smithiana</i> . Length 9.3 mm, height 5.8 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 33509.	
3. Length 9.7 mm, height 5.8 mm. Locality K 1429. No. G 14016.	
4,5. Length 10.0 mm, height 6.9 mm. Locality K 12255. No. G 14017.	
6-9. Caryocorbula (Caryocorbula) helenae (Maury)?	408
6,7. Length 14.8 mm, height 9.2 mm. Locality PJ 285. No. G 14018. 8. Length 14.9 mm, height 9.1 mm. Locality PJ 285. No. G 14019. 9. Length 13.3 mm, height 8.2 mm. Locality PJ 285. No. G 14020.	
10. Caryocorbula (Caryocorbula) species	409
Length 8.5 mm, height 6.2 mm. Locality JS 67. No. G 14021.	
11-15. Juliacorbula aequivalvis (Philippi)	410
11. Length 8.0 mm, height 5.6 mm. Locality JS 67. No. G 14009.	
12. Length 10.3 mm, height 6.8 mm. Locality RR 230. No. G 14010. 13-15. Length 8.6 mm, height 6.7 mm. Locality RR 230. No. G 14011.	



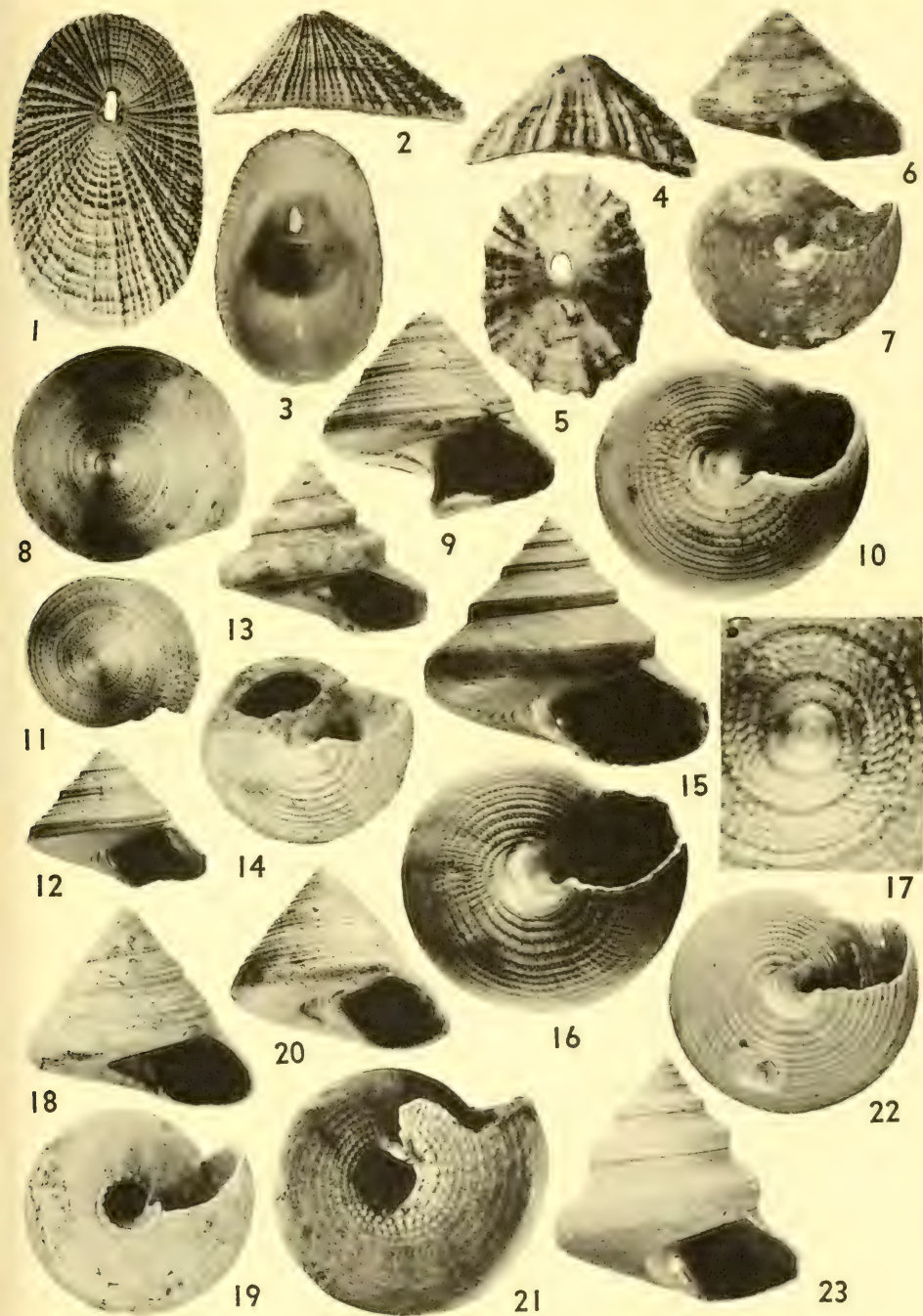


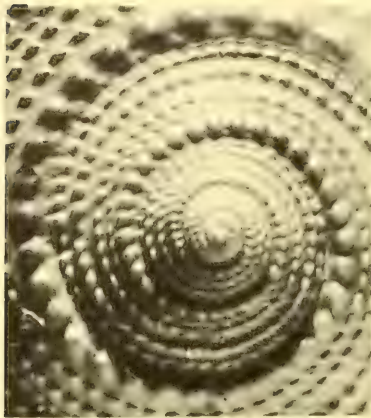
EXPLANATION OF PLATE 40

Figure	Page
1,2. Notocorbula islatrinitatis (Maury)	411
Length 13.6 mm, height 13.2 mm. USGS locality 18634. USNM 645353.	
3,4. Notocorbula species	412
3. Length 8.7 mm, height 6.7 mm. Locality PJ 285. No. G 14045.	
4. Length 9.0 mm, height 8.3 mm. Locality PJ 285. No. G 14046.	
5,6. Notocorbula aff. disparilis (d'Orbigny)	412
Length 9.3 mm, height 8.8 mm, Locality JS 67. No. G 14040.	
7-9. Tenuicorbula melajoensis , n. sp.	413
7,8. Holotype. Length 20.0 mm, height 9.6 mm. Locality Hutch 51. No. G 14047. 9. Paratype. Length 19.7 mm, height 9.7 mm. Locality Hutch 51. No. G 14048.	
10,11. Tenuicorbula aff. melajoensis , n. sp.	414
Length 12.0 mm, height 9.7 mm. Locality PJ 302. No. G 14052.	
12. Pholas mackiana Maury	414
Lectotype. Length of fragment 22.5 mm. Locality: on coast 700 feet east of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered.	
13. Martesia oligocenica Maury	415
Syntype. Length 11.5 mm, height 8.1 mm. Locality: milepost 49½ (new mileposts!) of the Southern Main Road of Trinidad, just south of the Pitch Lake (= USGS locality 21782). Cornell Univ., Paleont. Museum, unnumbered.	

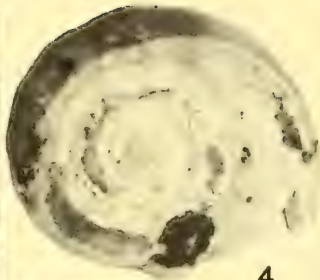
EXPLANATION OF PLATE 41

Figure	Page
1-3. Diodora cayenensis (Lamareck)	416
1. Length 17.6 mm, width 10.8 mm, height 6.0 mm. Locality RR 230. No. H 14561. 2,3. Length 14.0 mm, width 9.1 mm, height 5.9 mm. Locality RR 230. No. H 14562.	
4,5. Diodora (?) species	417
Length 12.7 mm, width 9.3 mm, height 6.3 mm. Locality RR 230. No. H 14566.	
6-12. Calliostoma decipiens (Guppy)	418
6,7. Lectotype. Height 8.7 mm, max. diameter 11.7 mm. Matura, coll. Guppy. USNM 115619. 8. Diameter 13.1 mm. Locality RR 230. No. H 14568. 9. Height 11.2 mm, diameter 12.7 mm. Locality RR 230. No. H 14569. 10. Diameter 15.0 mm. Locality RR 230. No. H 14570. 11,12. Height 7.5 mm, diameter 10.0 mm. Locality PJ 285. No. H 14571.	
13-17. Calliostoma laticarinatum (Guppy)	419
13,14. Holotype. Height 9.7 mm, max. diameter 11.4 mm. Matura, coll. Guppy. USNM 115618. 15,16. Height 13.6 mm, diameter 15.2 mm. Locality RR 230. No. H 14575. 17. Apical view of same specimen as figures 15 and 16. 10x.	
18-21. Calliostoma plicomphalus (Guppy)	420
18,19. Lectotype. Height 11.2 mm, max. diameter 12.2 mm. Matura, coll. Guppy. USNM 115617. 20. Height 9.7 mm, diameter 11.7 mm. Locality RR 230. No. H 14578. 21. Diameter 15.1 mm. Locality RR 230. No. H 14579.	
22,23. Calliostoma caronianum Maury	419
Height 14.6 mm, max. diameter 13.2 mm. USGS locality 18634. USNM 645348.	





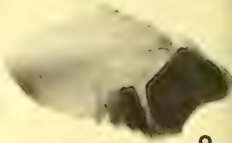
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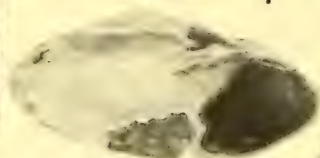
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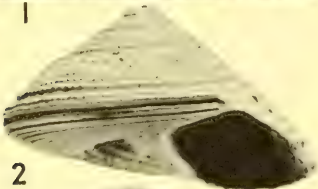
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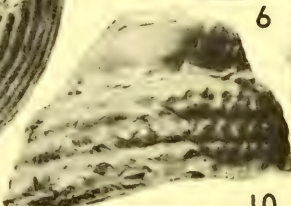
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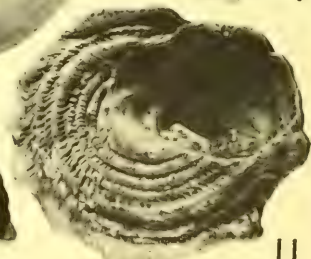
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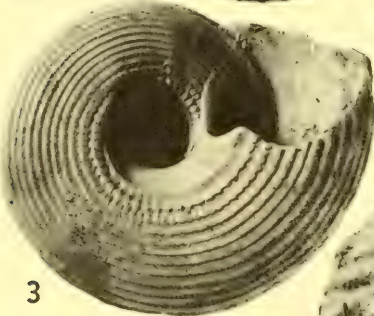
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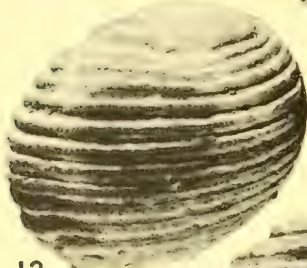
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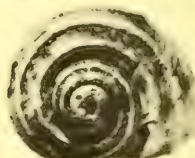
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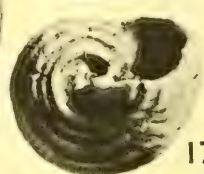
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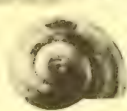
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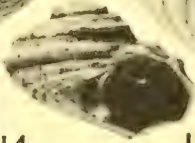
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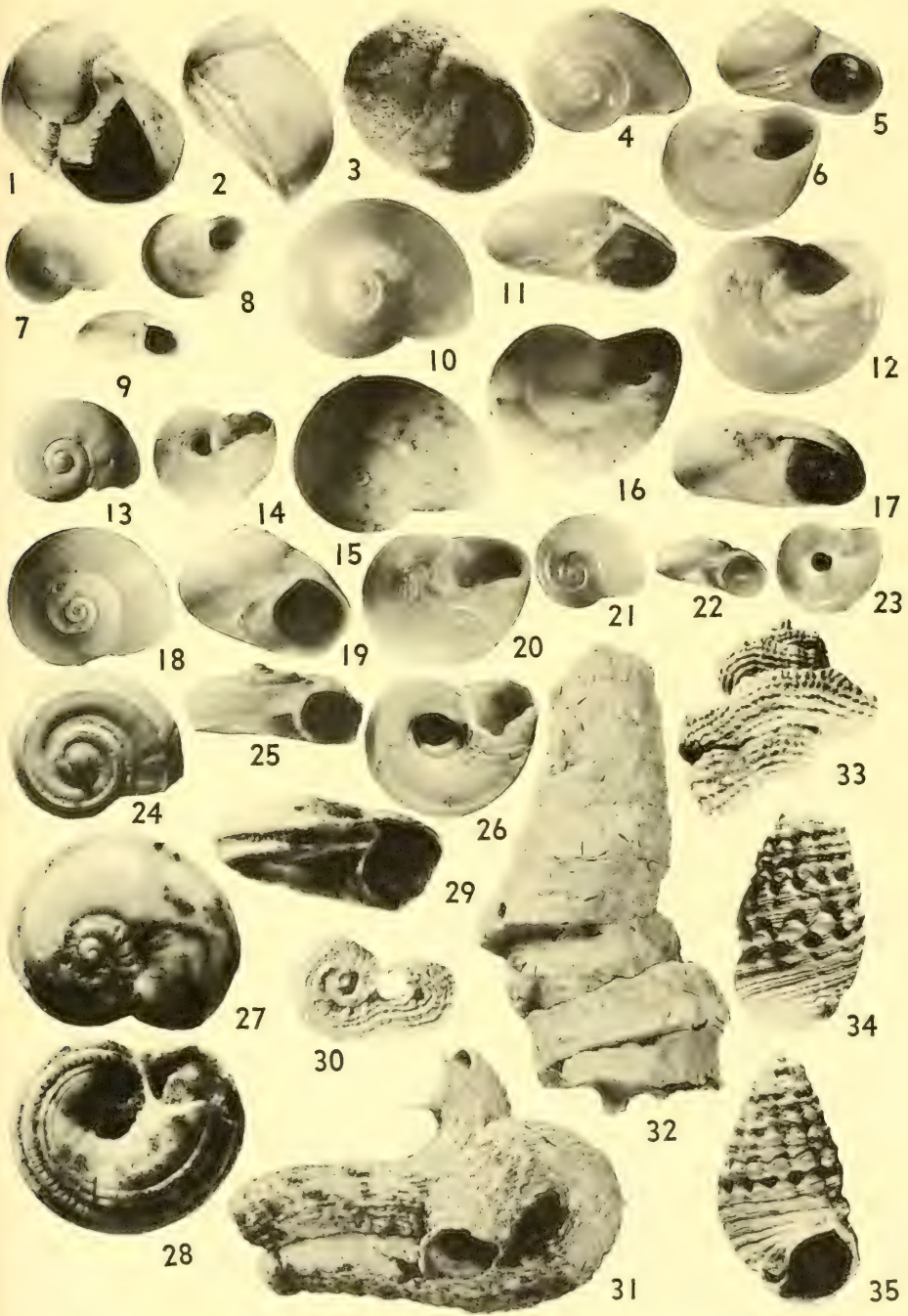
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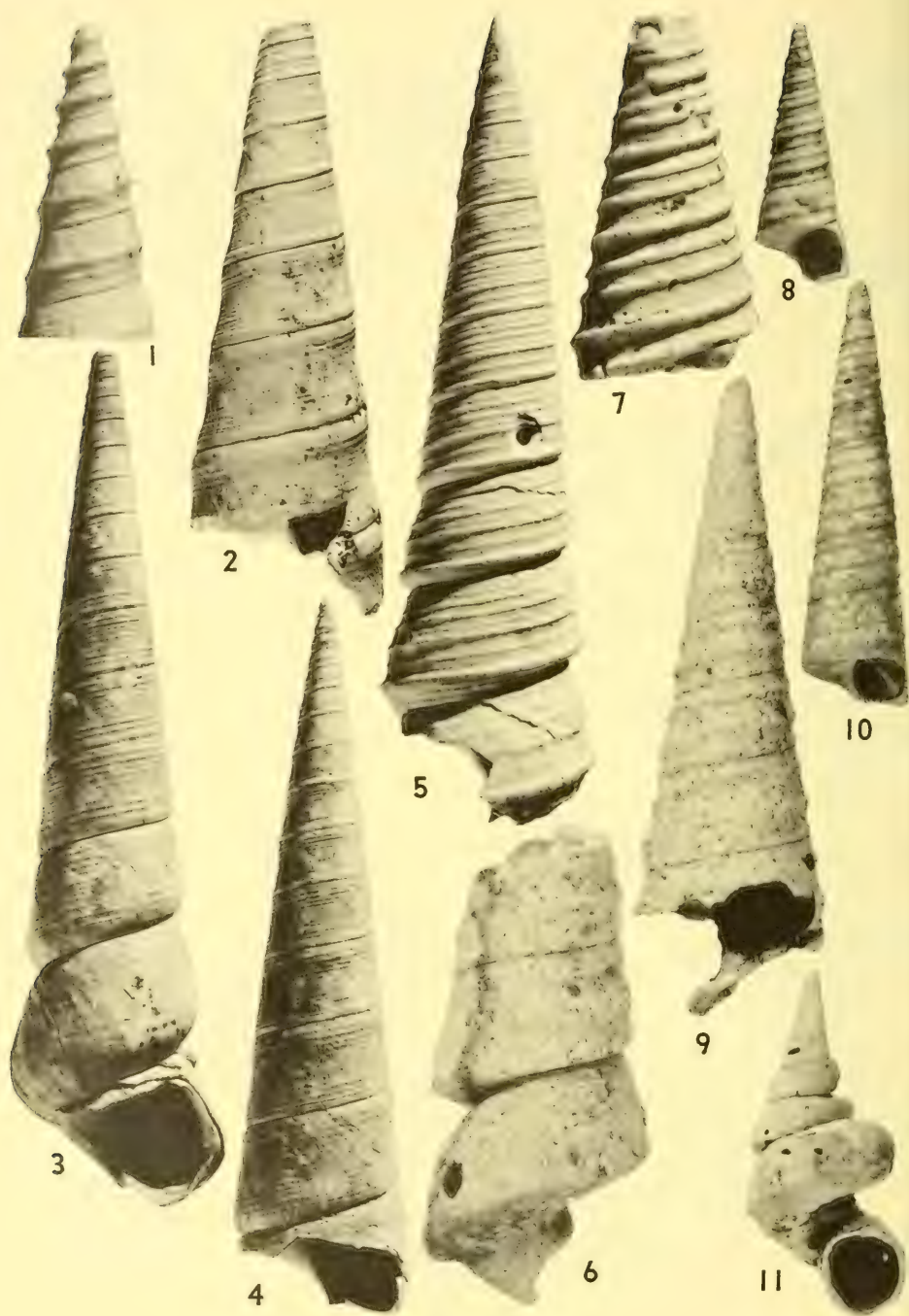
EXPLANATION OF PLATE 42

Figure	Page
1-3. Calliostoma olssoni Maury	421
1. Apical view, 10x. Locality PJ 285. No. H 14583. 2. Height 9.9 mm, diameter 16.7 mm. Locality Hutch 51. No. H 14584. 3. Diameter 19.9 mm. Locality RR 230. No. H 14582.	
4-9. Microgaza oblita , n. sp.	422
4-6. Holotype. Height 2.1 mm, max. diameter 4.2 mm. Matura, coll. Guppy. USNM 645185. 7,8. Paratype. Height 1.9 mm, diameter 3.2 mm. Locality RR 230. No. H 14597. 9. Paratype. Diameter 4.3 mm. Locality JS 67. No. H 14596.	
10,11. Astraea (Astraliium) cf. brevispina (Lamarek)	423
Height 11.3 mm, diameter 15.7 mm. Locality RR 230. No. H 14627.	
12,13. Nerita (Nerita) exuvioides Trechmann ?	424
Height 24.3 mm, diameter 27.0 mm. Locality Hutch 51. No. H 14630.	
14-17. Parviturbo maturensis , n. sp.	424
14. Paratype. Diameter 1.7 mm. Locality PJ 302. No. H 14626. 15-17. Holotype. Height 2.0 mm, diameter 2.9 mm. Locality PJ 302. No. H 14625.	

EXPLANATION OF PLATE 43

Figure		Page
1-3.	Neritina (Vitta) cf. virginea (Linné)	425
	1,2. Height 10.7 mm, diameter 10.0 mm. Locality Hutch 51. No. H 14631. 3. Height 10.2 mm, diameter 10.5 mm. Locality RR 230. No. H 14632.	
4-6.	Teinostoma (Pseudorotella) spretum , n. sp.	427
	Holotype. Height 1.5 mm, diameter 2.3 mm. Locality KR 11862. No. H 14607.	
7-9.	Teinostoma (Pseudorotella) nugax , n. sp.	427
	Holotype. Height 0.6 mm, diameter 1.6 mm. Locality KR 11862. No. H 14599.	
10-17.	Teinostoma (Aepystoma) caroniense Maury	428
	10-12. Height 3.1 mm, diameter 5.4 mm. Locality EL 1810. No. H 14603. 13,14. Immature specimen. Diameter 1.8 mm. Locality KR 11862. No. H 14610. 15-17. Height 1.9 mm, diameter 2.8 mm. Locality PJ 212. No. H 14615.	
18-20.	Teinostoma (Aepystoma) melaioense , n. sp.	429
	Holotype. Height 1.8 mm, diameter 2.4 mm. Locality PJ 285. No. H 14611.	
21-23.	Cochliolepis pluscula , n. sp.	430
	Holotype. Height 0.8 mm, diameter 1.6 mm. Locality PJ 285. No. H 14617.	
24-26.	Cyclostremiscus (Ponocyclus) pentagonus (Gabb)	431
	Height 1.2 mm, diameter 2.5 mm. Locality KR 11862. No. H 14619.	
27-29.	Solariorbis (subgenus ?) marginatus (Guppy)	432
	Height 0.8 mm, diameter 1.6 mm. Locality PJ 302. No. H 15345.	
30,31.	Serpulorbis decussatus (Gmelin)	444
	30. Length 4.4 mm. Locality PJ 212. No. H 14680. 31. Length 18.1 mm. USGS locality 18204. USNM 645350.	
32.	Petalococonchus sculpturatus alcimus Mansfield	444
	Height 43.8 mm. USGS locality 18634. USNM 645330.	
33.	Petalococonchus cf. floridanus Olsson and Harbison	445
	Greatest dimension 9.1 mm. Locality JS 67. No. H 14684.	
34,35.	Batillaria species	446
	34. Height 7.6 mm, diameter 4.3 mm. Locality K 9813. No. H 14686. 35. Height 8.4 mm, diameter 4.2 mm. Locality K 9813. No. H 14687.	



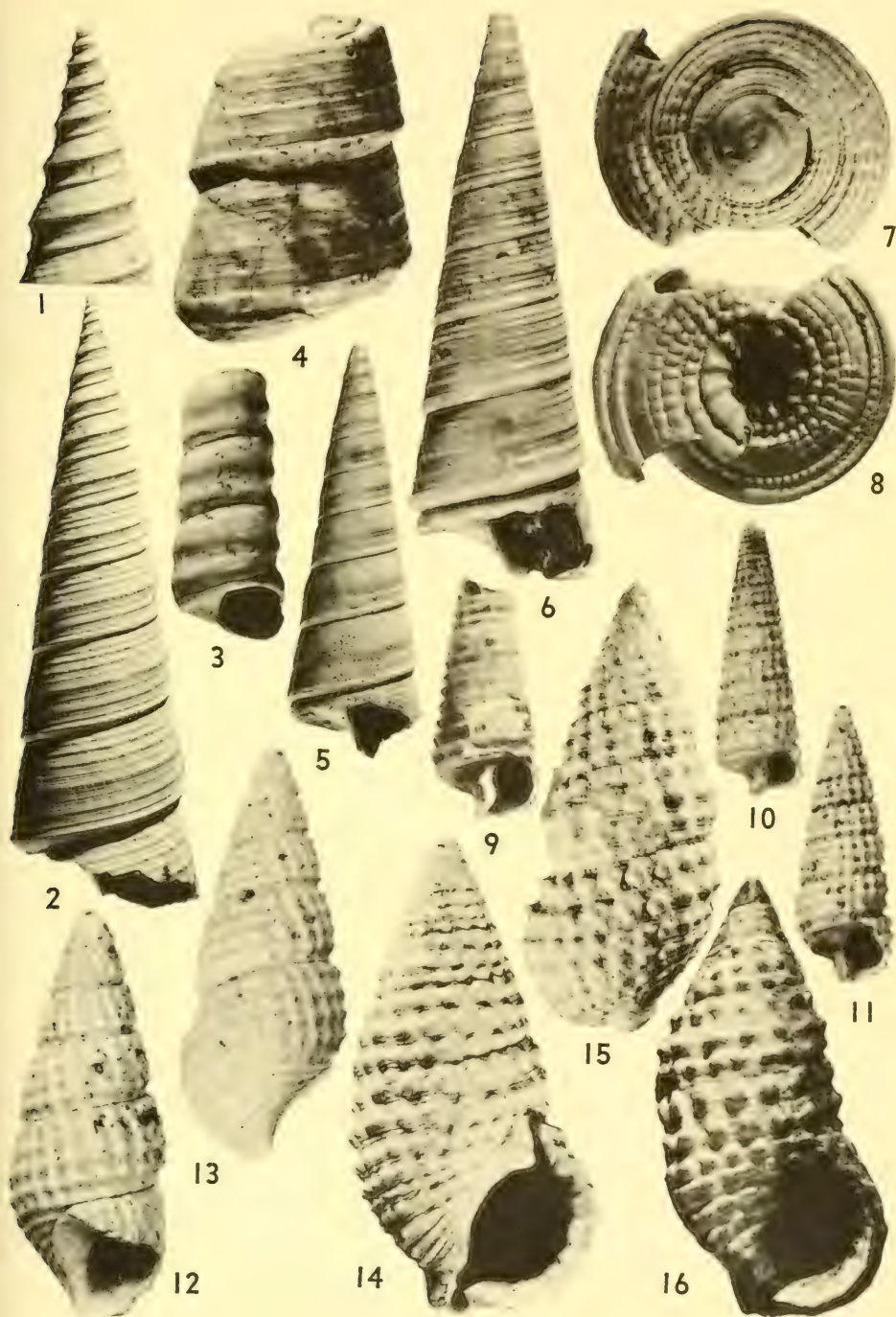


EXPLANATION OF PLATE 44

Figure	Page
1-4. Turritella (Broderiptella) bifastigata cartagenensis Pilsbry and Brown	436
1. Apex. 5x. Locality PJ 212, No. H 14529. 2. Height 41.0 mm, diameter 13.7 mm. Locality PJ 212, No. H 14544. 3. Height 118.4 mm, diameter 30.1 mm. Locality Hutch 51, No. H 14644. 4. Height 97.8 mm, diameter 24.2 mm. Locality Hutch 51, No. H 14645.	
5. Turritella (Broderiptella) aff. mimetes Brown and Pilsbry	437
Height 75.4 mm, diameter 21.0 mm, Locality Hutch 51, No. H 14650.	
6-10. Vermicularia (?) trilineata (Guppy)	442
6. Height 13.4 mm. USGS locality 19860. USNM 645364. 7. Height 10.2 mm, diameter 5.2 mm. Locality RR 230, No. H 14670. 8. Height 7.2 mm, diameter 2.6 mm. Locality RR 230, No. H 14671. 9. Height 17.6 mm, diameter 5.2 mm. USGS locality 19860. USNM 645365. 10. Lectotype. Height 12.0 mm, diameter 2.1 mm, Matura, coll. Guppy. USNM 115455.	
11. Vermicularia spirata (Philippi) ?	442
Height 16.2 mm. Matura, coll. Guppy. USNM 115453.	

EXPLANATION OF PLATE 45

Figure	Page
1,2. Turritella (Broderiptella) planigyrate Guppy	437
1. Apex of same specimen as figure 2; 5x. 2. Height 43.1 mm, diameter 13.1 mm. Locality PJ 285. No. H 14656.	
3. Turritella (Bactrospira) species	440
Height 19.1 mm, diameter 7.9 mm. Locality RR 230. No. H 14669.	
4-6. Turritella (Broderiptella) aff. planigyrate Guppy	439
4. Height 23.2 mm, diameter 17.0 mm. Locality RR 230. No. H 14666. 5. Height 28.1 mm, diameter 9.2 mm. Locality RR 230. No. H 14664. 6. Height 32.4 mm, diameter 10.5 mm. Locality RR 230. No. H 14665.	
7,8. Architectonica (Architectonica) nobilis nobilis Röding	452
Height 9.5 mm, diameter 17.8 mm. Locality RR 230. No. H 14638.	
9. Seila cf. adamsi (H. C. Lea)	451
Height 3.5 mm, diameter 1.7 mm. USGS locality 19860. USNM 645369.	
10. Cerithiopsis (subgenus ?) emersoni (C. B. Adams)	450
Height 7.8 mm, diameter 2.9 mm. USGS locality 19860. USNM 645363.	
11. Cerithiopsis (Cerithiopsis) species	449
Height 4.0 mm, diameter 1.5 mm. USGS locality 19860. USNM 645370.	
12,13. Bittium (Bittiolium) fretense , n. sp.	448
Holotype. Height 5.6 mm, diameter 2.0 mm. USGS locality 10991. USNM 645372.	
14-16. Cerithium (subgenus ?) harrisi Maury	447
14. Height 22.0 mm, diameter 11.1 mm. Locality K 12255. No. H 14691. 15. Height 20.7 mm, diameter 9.1 mm. Locality K 12255. No. H 14690. 16. Lectotype. Height 15.2 mm, diameter 7.5 mm. Locality: on coast 700 feet east of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered.	



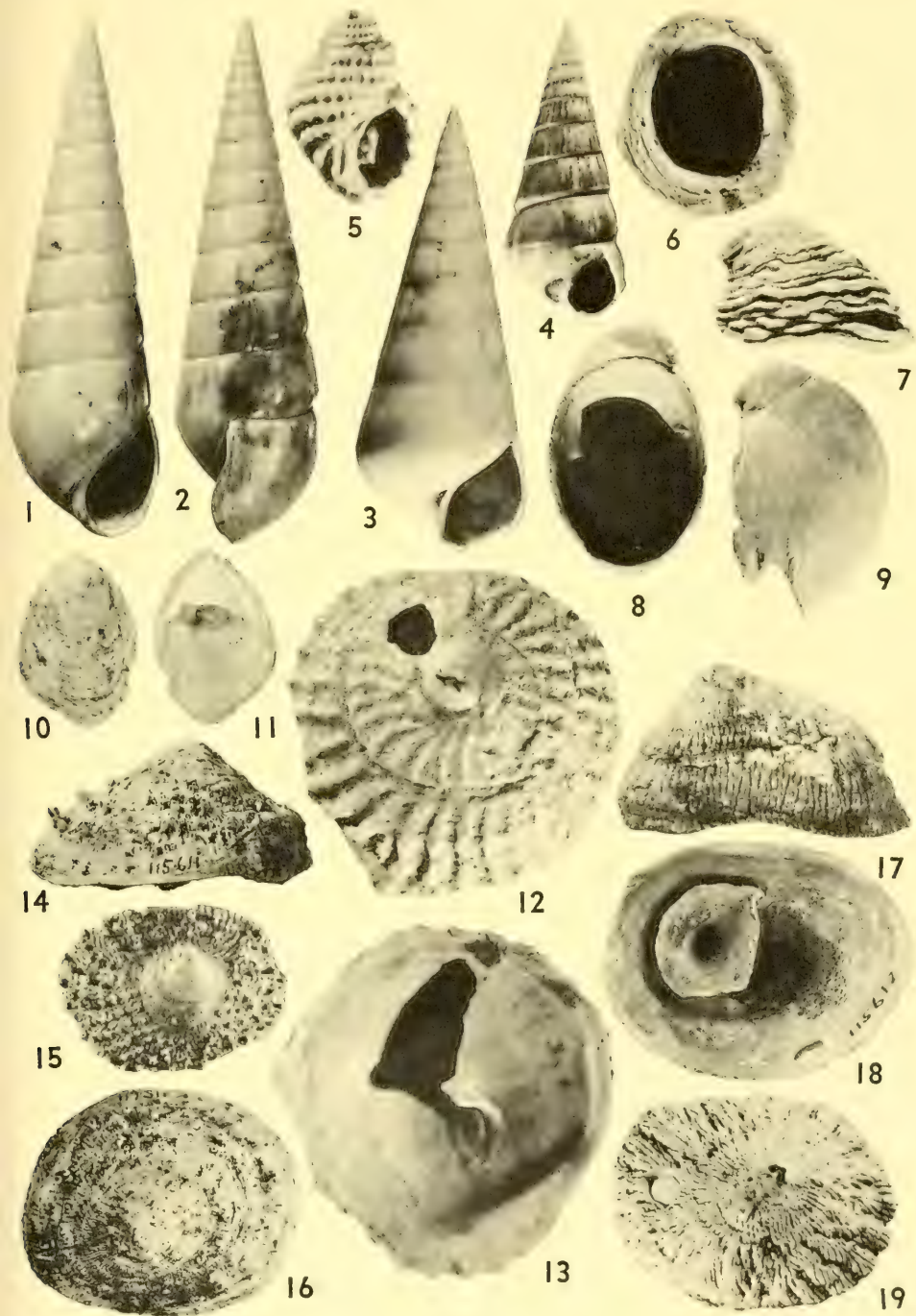


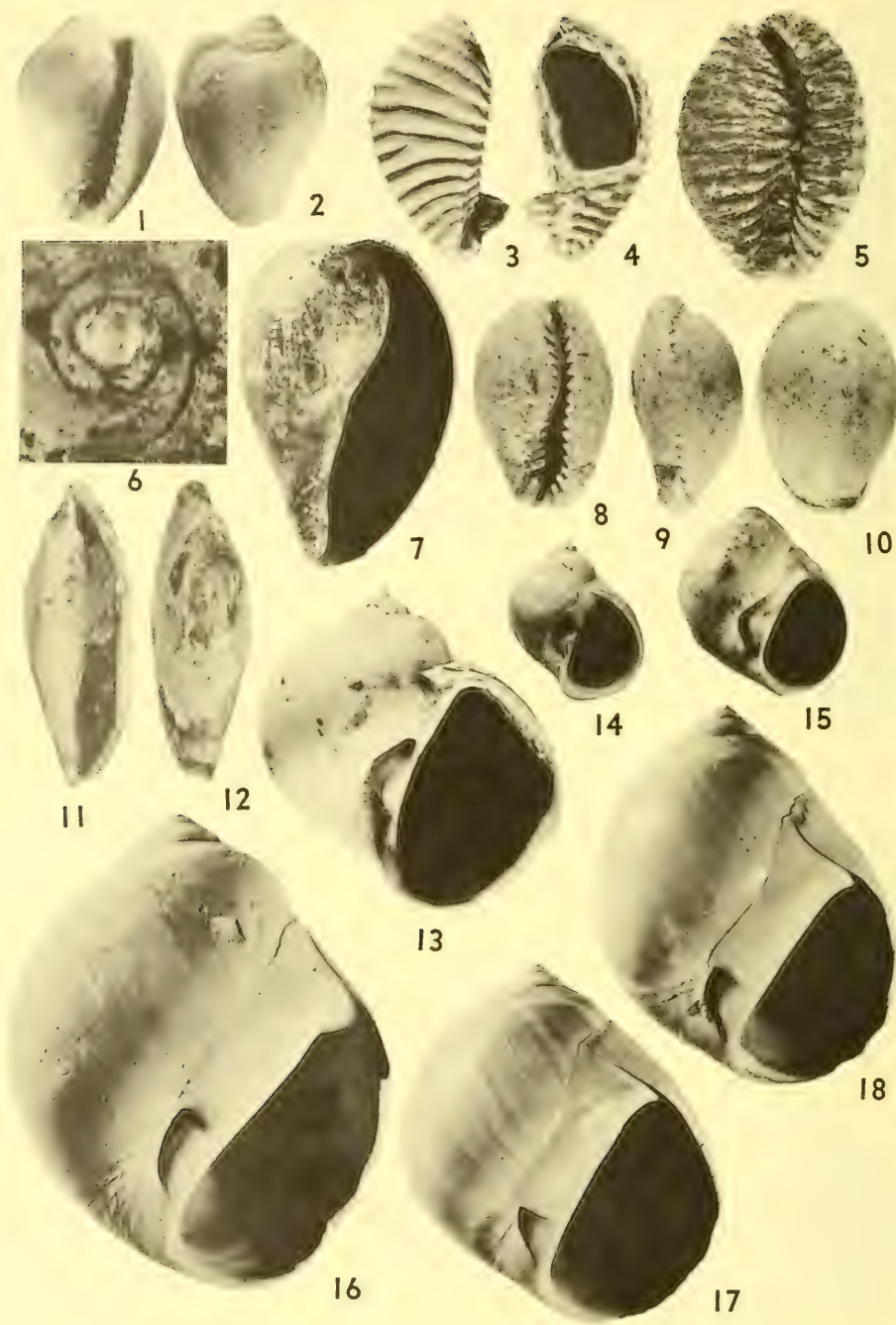
EXPLANATION OF PLATE 46

Figure		Page
1-3.	Architectonica (Pseudotorinia) melajoensis , n. sp.	453
	Holotype. Height 2.0 mm, diameter 4.8 mm. Locality PJ 285. No. H 14640.	
4-6.	Architectonica (Pseudotorinia) guppyi , n. sp.	454
	Holotype. Height 2.0 mm, diameter 4.2 mm. Locality JS 67. No. H 14641.	
7-9.	Architectonica (Pseudotorinia) cf. semidecussata (Guppy)	456
	Height 4.2 mm, diameter 7.2 mm. USGS locality 10991. USNM 645361.	
10,11.	Architectonica (Pseudotorinia) semidecussata (Guppy)	455
	Holotype. Height 2.1 mm, diameter 4.0 mm. Matura, coll. Guppy. USNM 115468.	
12,13.	Mathilda species A	456
	Height 10.2 mm, diameter 3.9 mm. USGS locality 18411. USNM 645362.	
14-16.	Triphora guttata (Guppy)	458
	14,15. Height 3.6 mm, diameter 1.3 mm. USGS locality 10991. USNM 645371. 16. Holotype. Height 3.1 mm, diameter 1.3 mm. Matura, coll. Guppy. USNM 115458.	
17.	Epitonium (Epitonium) albidum (d'Orbigny)	459
	Height 9.7 mm, diameter 4.4 mm. Locality RR 230. No. H 14697.	
18.	Epitonium (Epitonium) humphreysi (Kiener) ?	460
	Height 10.0 mm, diameter 6.3 mm. USGS locality 10991. USNM 645357.	
19.	Epitonium (Asperiscala) cf. multistriatum (Say)	461
	Height 5.9 mm, diameter 3.0 mm. Locality RR 230. No. H 15048.	
20,21.	Epitonium (Epitonium) maturense , n. sp.	460
	Holotype. Height 18.9 mm, diameter 8.1 mm. Locality RR 230. No. H 15040.	
22.	Epitonium (Asperiscala) cf. candeanum (d'Orbigny)	462
	Height 5.4 mm, diameter 2.3 mm. Locality PJ 302. No. H 15049.	
23-25.	Epitonium (Asperiscala) rohri , n. sp.	462
	23,24. Holotype. Height 4.8 mm, diameter 1.6 mm. Locality PJ 285. No. H 15042. 25. Paratype. Height 3.0 mm, diameter 1.4 mm. Locality KR 11862. No. H 15043.	
26.	Eulima clavata (Guppy)	464
	Lectotype. Height 6.7 mm, diameter 1.7 mm. Matura, coll. Guppy. USNM 115443.	
27.	Eulima species A	464
	Height 10.2 mm, diameter 2.3 mm. USGS locality 21178. USNM 645360.	

EXPLANATION OF PLATE 47

Figure		Page
1,2.	Balcis egregia (Guppy) Height 49.5 mm, diameter 14.4 mm. USGS locality 18634. USNM 645328.	465
3,4.	Niso grandis Gabb ? 3. Height 15.7 mm, diameter 6.3 mm. Locality PJ 285. No. H 15058. 4. Height 10.0 mm, diameter 4.1 mm. Locality PJ 285. No. H 15059.	466
5.	Fossarus (Iselica) anomalus (C. B. Adams) ? Height 2.8 mm, diameter 1.8 mm. Locality PJ 302. No. H 15066.	468
6,7.	Hipponix cf. antiquatus (Linné) Height 9.0 mm, diameter 14.4 mm. Locality RR 230. No. H 15068.	469
8,9.	Crepidula (Crepidula) cf. maculosa Conrad Length 23.5 mm, width 14.0 mm. Locality Hutch 51. No. H 15100.	470
10,11.	Crepidula plana Say Height 14.7 mm, width 9.8 mm. USGS locality 18634. USNM 645343.	470
12,13.	Trochita radians (Lamarek) Height 9.2 mm, diameter 24.6 mm. Locality RR 230. No. H 15082.	473
14-16.	Crucibulum (Crucibulum) piliferum Guppy 14,16. Lectotype. Height 10.8 mm, diameter 23.0 mm. Matura, coll. Guppy. USNM 115611. 15. Diameter 7.8 mm. Locality JS 67. No. H 15086.	475
17-19.	Crucibulum (Crucibulum) subsutum Guppy 17,18. Lectotype. Height 12.7 mm, diameter 24.0 mm. Matura, coll. Guppy. USNM 115612.	474





EXPLANATION OF PLATE 48

Figure	Page
1,2. Erato maugeriae Gray	476
Height 5.5 mm, diameter 4.1 mm, Locality RR 230. No. H 15107.	
3-5. Trivia (Pusula) radians orientalis (Schilder)	477
3,4. Holotype. Length 17.1 mm. Matura. No. H 11228. 5. Para-	
type, Height 18.7 mm, width 13.2 mm. Matura. No. H 11229.	
6,7. Cypraea species	478
6. Apical view of same specimen as figure 7; 5x. 7. Height 29.8	
mm, diameter 20.6 mm. Locality RR 230. No. H 15111.	
8-10. Cypraea (Erosaria) aliena (Schilder)	479
Holotype. Height 15.0 mm, diameter 9.7 mm. Matura. No. H	
11263.	
11,12. Neosimnia cf. uniplicata (G. B. Sowerby II)	479
Height 10.2 mm, diameter 4.9 mm. USGS locality 18204. USNM	
645358.	
13,14. Natica (Naticarius) aff. canrena (Linné)	481
13. Height 22.5 mm, diameter 21.0 mm. Locality K 12255. No.	
H 15124. 14. Height 12.4 mm, diameter 10.3 mm. USGS locality	
18634. USNM 645344.	
15. Tectonatica pusilla (Say)	482
Height 4.2 mm, diameter 3.8 mm. Locality JS 67. No. H 15133.	
16-18. Polinices stanislasmeunieri Maury	483
16. Height 43.5 mm, diameter 36.0 mm. Locality Hutch 51. No.	
H 15145. 17. Height 33.8 mm, diameter, 29.2 mm. Locality PJ	
285. No. H 15146. 18. Height 36.2 mm, diameter 27.7 mm.	
Locality PJ 285. No. H 15147.	

EXPLANATION OF PLATE 49

Figure	Page
1,2. Bursa (Bursa) aff. thomae (d'Orbigny).....	486
Height 26.5 mm, diameter 19.1 mm. USGS locality 18634. USNM 645345.	
3-6. Bursa (Marsupina) bufo (Bruguière).....	487
3,4. Height 25.2 mm, width 17.8 mm. Locality RR 230. No. H 15151. 5,6. Height 75 mm, width 45 mm. Locality RR 230. No. H 15150.	
7. Murex (Chicoreus) cf. brevifrons Lamarck	491
Height 46.3 mm. USGS locality 21778. USNM 645333.	
8-10. Murex (Murex) chrysostoma G. B. Sowerby I	489
8,9. Height 35.4 mm, diameter 26.1 mm. USGS locality 18411. USNM 645332. 10. Height 41.5 mm, diameter 34.0 mm. USGS locality 18634. USNM 645331.	





EXPLANATION OF PLATE 50

Figure	Page
1-4. Eupleura lehneri , n. sp.	491
1,2. Holotype. Height 27.0 mm, width 19.6 mm. USGS locality 21178. USNM 645346. 3. Paratype. Height 23.6 mm, width 16.2 mm. Locality PJ 285. No. H 15159. 4. Paratype. Height 12.1 mm, width 8.8 mm. Locality PJ 285. No. H 15160.	
5,6. Typhis (Typhinellus) cf. quadratus Hinds	493
Height 16.2 mm, width 9.3 mm. Locality JS 67. No. H 15161.	
7-9. Calothrophon (?) hutchisoni , n. sp.	494
7. Paratype. Height 15.6 mm, diameter 9.0 mm. USGS locality 18399. USNM 645495. 8,9. Holotype. Height 16.6 mm, diameter 9.4 mm. USGS locality 21178. USNM 645494.	
10-13. Risomurex galbensis , n. sp.	495
10. Paratype. Height 14.7 mm, diameter 8.7 mm. USGS locality 10991. USNM 645366. 11. Paratype. Protoconch; 10x. USGS locality 21778. USNM 645374. 12,13. Holotype. Height 13.8 mm, diameter 7.7 mm. USGS locality 10991. USNM 645367.	

EXPLANATION OF PLATE 51

Figure	Page
1-4. Cymia brightoniana Maury	497
1,2. Holotype, Height 55.0 mm, width 39.2 mm. Locality: on coast 700 feet east of Brighton pier near Pitch Lake, Trinidad. Cor- nell Univ., Paleont. Museum, No. 33609. 3,4. Height 53.5 mm, diameter 33.6 mm. USGS locality 20432a, USNM 645334.	
5,6. Thais (Stramonita) species A	497
Height 28.0 mm, diameter 18.5 mm. USGS locality 18634. USNM 645347.	
7-9. Parametaria prototypus (Guppy)	499
7,8. Holotype. Height 12.2 mm, diameter 7.8 mm. Guppy's Sava- netta (Caroni Series). USNM 115593. 9. Height 11.4 mm, dia- meter 6.6 mm. USGS locality 18634. USNM 645352.	



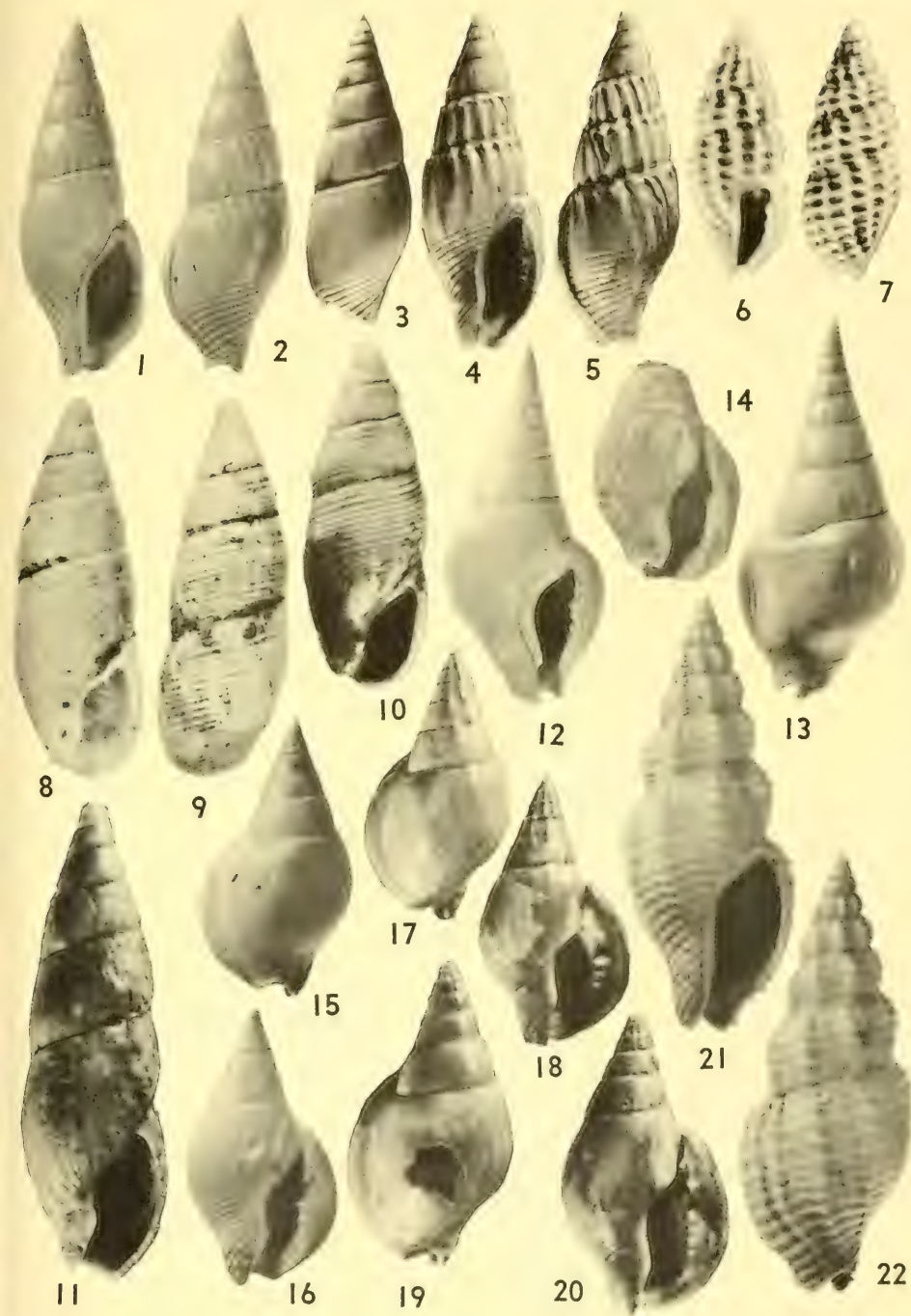


EXPLANATION OF PLATE 52

Figure	Page
1,2. Parametaria prototypus (Guppy)	499
Height 23.5 mm, diameter 14.3 mm. USGS locality 18634. USNM 645351.	
3-6. Parametaria rutschi , n. sp.	500
3,4. Holotype. Height 22.2 mm, diameter 15.0 mm. Locality RR 230. No. H 15171. 5,6. Paratype. Height 16.3 mm, diameter 10.5 mm. Locality RR 230. No. H 15172.	
7-10. Anachis (Anachis) asphaltoda (Maury)	501
7,8. Syntype. Height 14.7 mm, diameter 6.9 mm. Locality: on coast 700 feet east of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, No. 33511, 9,10. Height 15.2 mm, diameter 6.8 mm. Locality K 12255. No. H 15176.	
11. Anachis (Costoanachis) obesa (C. B. Adams)	503
Height 5.0 mm, diameter 2.7 mm, Locality PJ 212. No. H 15174.	

EXPLANATION OF PLATE 53

Figure	Page
1-5. Anachis (Costoanachis) fraudans , n. sp.	504
1,2. Holotype. Height 12.1 mm, diameter 4.2 mm. USGS locality 21178. USNM 645502. 3. Paratype. Height 10.2 mm, diameter 3.8 mm. Locality KR 11862. No. H 15201. 4,5. Paratype. Height 11.7 mm, diameter 4.3 mm. Locality PJ 285. No. H 15202.	
6,7. Zanassarina species	505
Height 3.5 mm, diameter 1.3 mm. Locality JS 67. No. H 15188.	
8-10. Aesopus peculiaris (Guppy)	505
8,9. Lectotype. Height 5.0 mm, diameter 1.8 mm, Matura, coll. Guppy. USNM 115520. 10. Height 4.8 mm, diameter 1.7 mm. Locality RR 230. No. H 15189.	
11. Aesopus aff. metcalfei (Reeve)	507
Height 8.0 mm, diameter 2.6 mm. Locality RR 230. No. H 15192.	
12,13. Strombina (subgenus ?) melajoensis , n. sp.	507
Holotype. Height 16.9 mm, diameter 7.1 mm. USGS locality 18634. USNM 645493.	
14-20. Strombina (Sincola) crassilabrum (Guppy)	508
14. Lectotype. Height 7.7 mm, diameter 5.1 mm. Matura, coll. Guppy. USNM 115492. 15,16. Height 9.5 mm, diameter 5.1 mm. USGS locality 10991. USNM 645501. 17,18. Height 9.6 mm, diameter 5.2 mm. Locality PJ 285. No. H 15199. 19,20. Height 10.5 mm, diameter 5.6 mm. Locality RR 230. No. H 15200.	
21,22. Strombinophos perdoctus , n. sp.	510
Holotype. Height 14.8 mm, diameter 6.0 mm. USGS locality 21178. USNM 645503.	



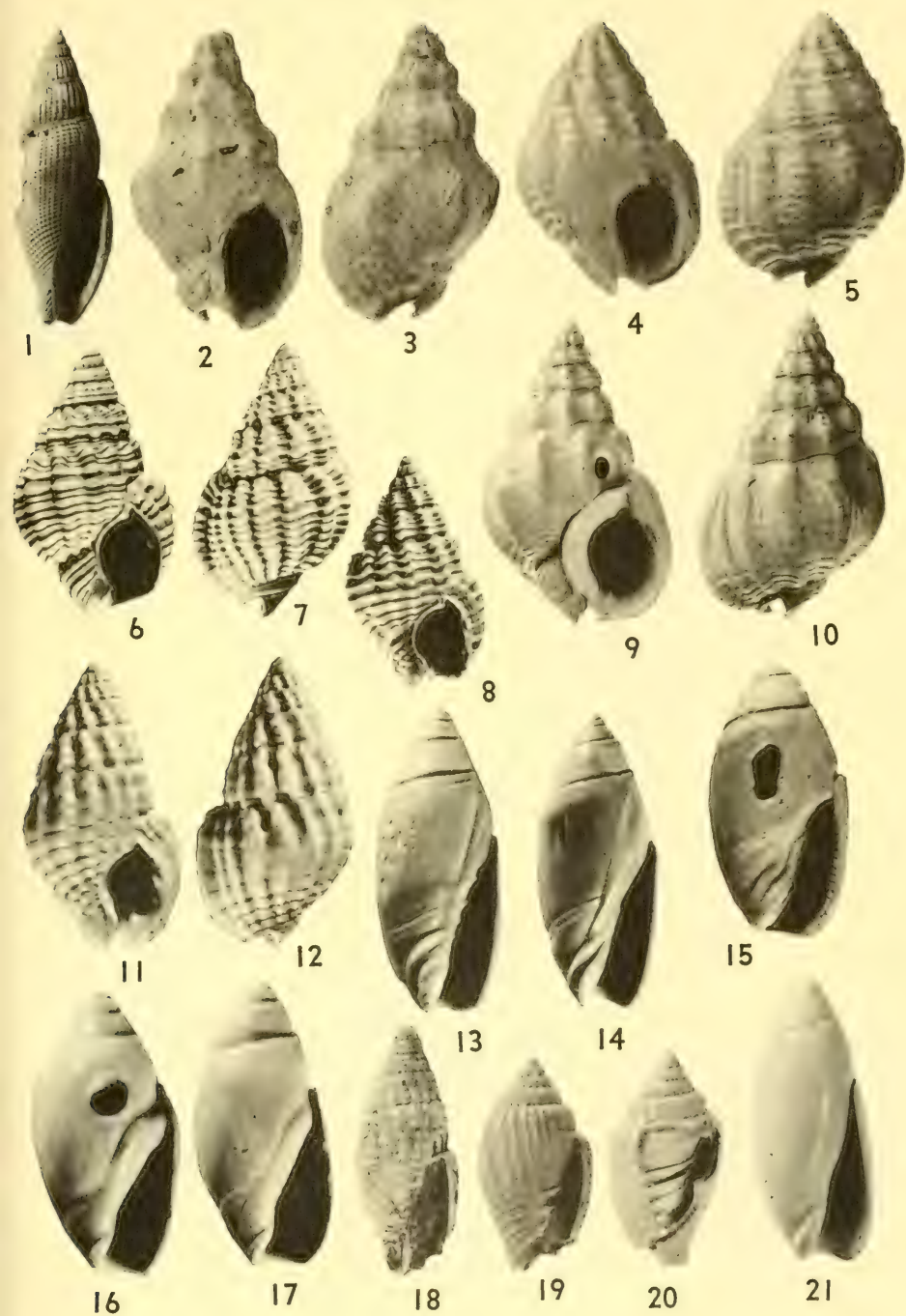


EXPLANATION OF PLATE 54

Figure	Page
1-4. Buccinid indet	511
1,2. Height 46.2 mm, diameter 25.6 mm. USGS locality 10991. USNM 645470. 3. Height 32.0 mm, diameter 28.1 mm. Locality K 12255. No. H 15203. 4. Height 35.0 mm, diameter 18.2 mm. USGS locality 20432. USNM 645471.	
5,6. Cantharus (subgenus ?) species A	512
Height 30.4 mm, diameter 17.6 mm. USGS locality 18634. USNM 645472.	
7-10. Calophos rohri (Rutsch)	514
7,8. Height 41.2 mm, diameter 22.4 mm. Locality Hutch 51. No. H 15215. 9,10. Height 43.0 mm, diameter 23.3 mm. Locality EL 1810. No. H 15216.	
11,12. Metaphos (?) species	515
Height 25.3 mm, diameter 10.0 mm. USGS locality 21778. USNM 645482.	

EXPLANATION OF PLATE 55

Figure	Page
1. Metula aff. cancellata Gabb	515
Height 23.1 mm, diameter 7.5 mm. USGS locality 21178. USNM 645483.	
2,3. Pallacera species A	516
Height 23.4 mm, diameter 13.2 mm. USGS locality 18411. USNM 645484.	
4,5. Nassarius (Phrontis) vibex (Say)	517
Height 9.5 mm, diameter 6.1 mm. USGS locality 10991. USNM 645504.	
6-8. Nassarius (Uzita) trinitatensis , n. sp.	518
6,7. Holotype. Height 9.3 mm, diameter 5.3 mm. Locality PJ 285. No. H 15221. 8. Paratype. Height 8.1 mm, diameter 4.8 mm. Locality PJ 285. No. H 15222.	
9,10. Nassarius (Uzita) species A	519
Height 13.7 mm, diameter 8.1 mm. USGS locality 18411. USNM 645496.	
11,12. Nassarius (subgenus ?) galbanus , n. sp.	520
Holotype. Height 7.7 mm, diameter 4.1 mm. Locality K 1429. No. H 15235.	
13. Olivella (Olivella) species	526
Height 6.9 mm, diameter 3.0 mm. Locality RR 230. No. H 15249.	
14. Olivella (Dactylidia) aff. mutica (Say)	527
Height 8.4 mm, diameter 3.3 mm. Locality PJ 285. No. H 15258.	
15. Olivella (Niteoliva) cf. verreauxi (Ducros)	527
Height 7.7 mm, diameter 4.0 mm. Locality RR 230. No. H 15250.	
16,17. Olivella (Minioliva) fundarugata Weisbord	528
16. Height 3.8 mm, diameter 2.2 mm. Locality KR 11862. No. H 15259. 17. Height 4.0 mm, diameter 2.0 mm. Locality KR 11862. No. H 15260.	
18. Scabricola nodulosa (Gmelin)	531
Height 20.0 mm, diameter 7.8 mm. USGS locality 19860. USNM 645485.	
19,20. Conomitra species A	532
Height 16.9 mm, diameter 8.6 mm. USGS locality 18411. USNM 645486.	
21. Jaspidella sanctidominici (Maury)	526
Height 12.7 mm, diameter 5.0 mm. USGS locality 18411. USNM 645497.	





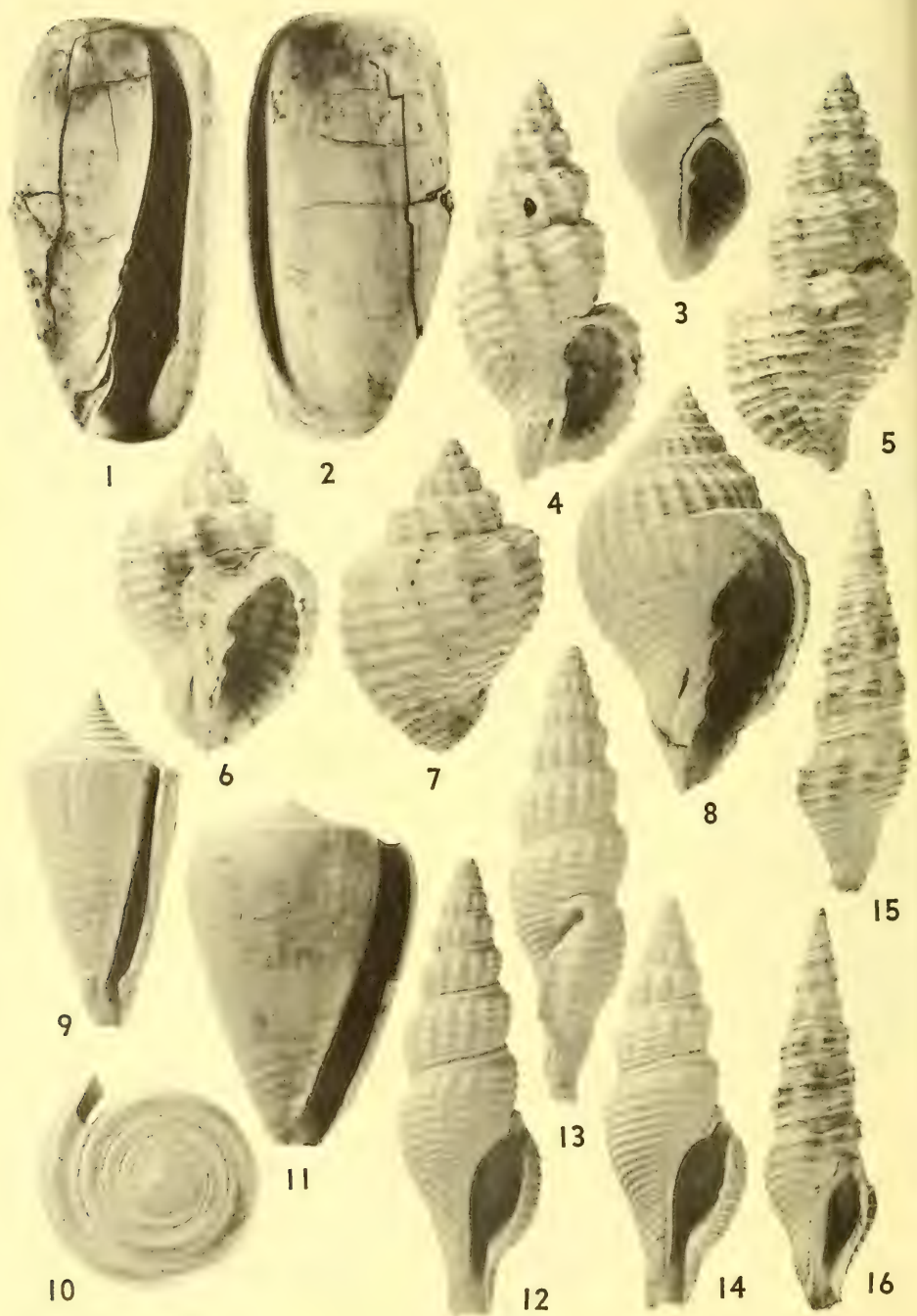
EXPLANATION OF PLATE 56

Figure	Page
1,2. Melongena melongena (Linné) Height 38.3 mm. USGS locality 20432. USNM 645473.	521
3. Fusinus species Height 44.0 mm, diameter 15.3 mm. USGS locality 18411, USNM 645474.	523
4-6. Fasciolaria (Pleuroploca) turamensis , n. sp. 4,5. Holotype. Height 56.3 mm, diameter 28.5 mm. Locality RR 230. No. H 15243. 6. Paratype. Height 50.4 mm, diameter 29.0 mm. Locality RR 230. No. H 15244.	522
7. Oliva trinidadensis Maury Lectotype. Height 14.2 mm, diameter 7.8 mm. Locality: milepost 49 3/4 (new mileposts!) of the Southern Main Road of Trinidad, just south of the Pitch Lake (= USGS locality 21782). Cornell Univ., Paleont. Museum, unnumbered.	525
8. Oliva (Oliva) couvana Maury Height 47.3 mm, diameter 19.3 mm. USGS locality 18634. USNM 645475.	525

EXPLANATION OF PLATE 57

Figure	Page
1-4. Prunum (Prunum) dallianum (Maury)	533
1,2. Lectotype. Height 20.3 mm, diameter 13.2 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered. 3,4. Paralectotype. Height 21.6 mm, diameter 13.1 mm. Locality: on coast 1000 feet west of Brighton pier near Pitch Lake, Trinidad. Cornell Univ., Paleont. Museum, unnumbered.	
5,6. Prunum (Egouena) springvalense (Maury)	534
Height 34.4 mm, diameter 20.4 mm, USGS locality 18634. USNM 645476.	
7,8. Bullata maiae (Maury)	538
Height 66.1 mm, diameter 36.0 mm. USGS locality 20429; 1700 feet southwest of Philippine Estate, Savaneta River area, Trinidad. USNM 645469.	
9,10. Prunum (Egouena) calypsonis (Maury)	534
Height 22.6 mm, diameter 12.5 mm. USGS locality 18634. USNM 645487.	
11,12. Persicula (Rabicea) cf. interruptolineata (Megerle von Mühlfeld)	537
11. Height 13.6 mm, diameter 10.7 mm. Locality RR 230. No. H 15277. 12. Height 10.8 mm, diameter 7.8 mm. Locality RR 230. No. H 15278.	
13-15. Persicula (Rabicea) couviana (Maury)	536
13. Height 15.8 mm, diameter 11.0 mm. USGS locality 18634. USNM 645489. 14,15. Height 13.1 mm, diameter 9.0 mm. USGS locality 18634. USNM 645488.	
16. Volvarina (?) species B	536
Height 14.0 mm, diameter 7.1 mm. USGS locality 20432. USNM 645491.	
17. Volvarina (?) species A	536
Height 15.8 mm, diameter 7.7 mm. USGS locality 18634. USNM 645490.	



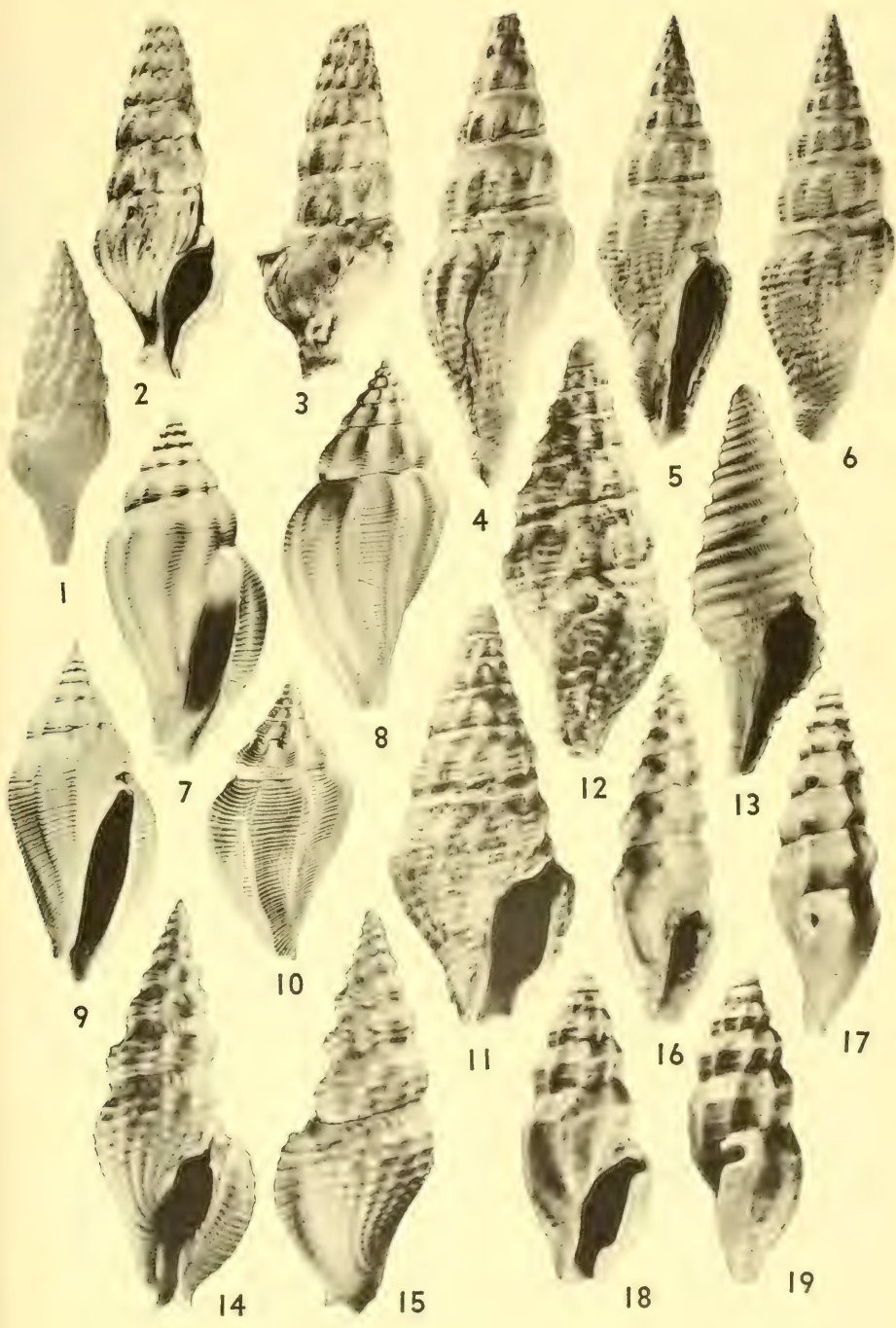


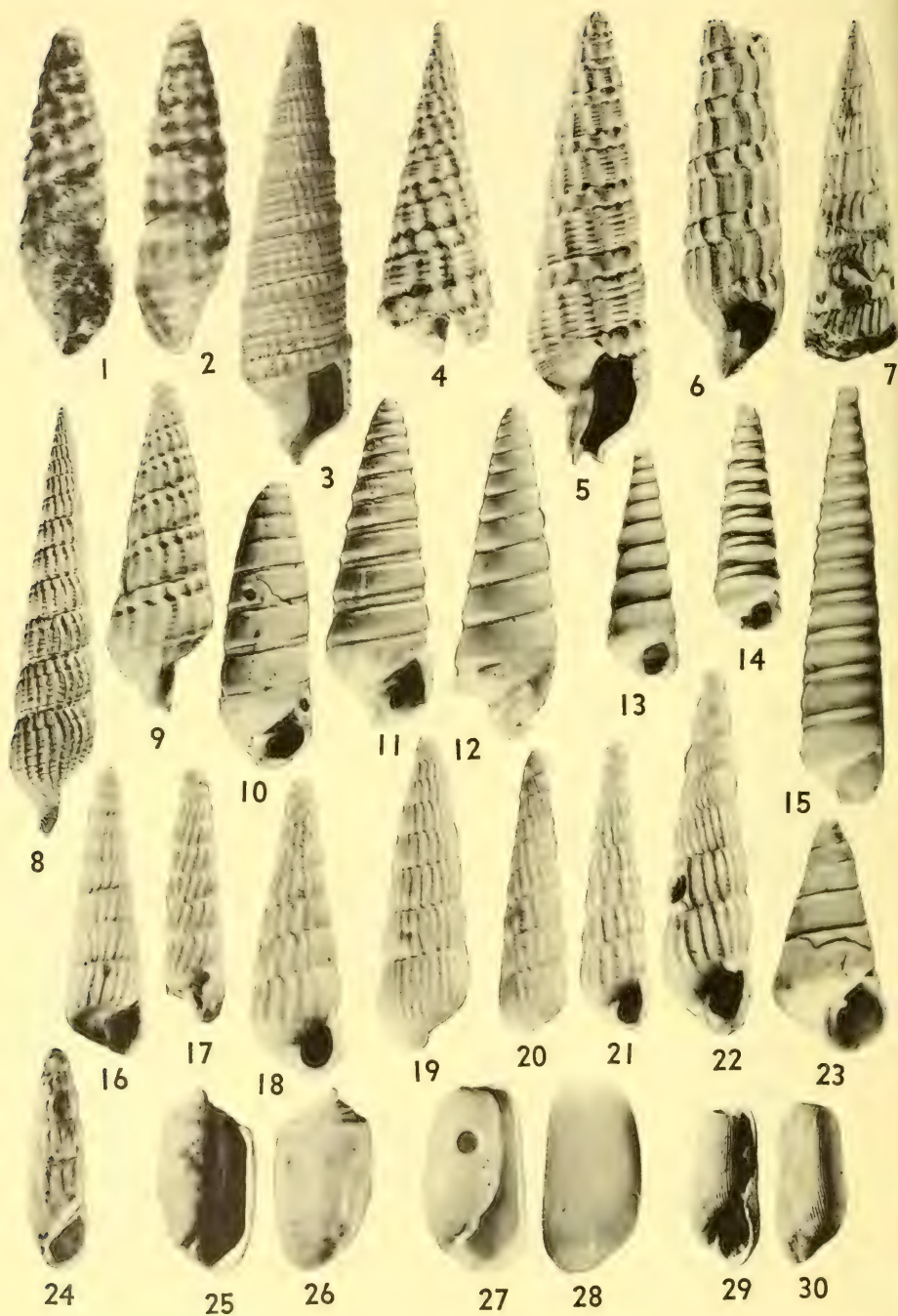
EXPLANATION OF PLATE 58

Figure		Page
1,2.	Bullata maturensis , n. sp. Holotype. Height 40.0 mm, diameter 19.5 mm. Locality RR 230. No. H 15270.	538
3.	Cancellaria (Charcolleria) species Height 20.6 mm, diameter 10.1 mm. USGS locality 18634. USNM 645492.	542
4,5.	Cancellaria (Narona) semota , n. sp. Holotype. Height 17.7 mm, diameter 8.0 mm. USGS locality 21178. USNM 645498.	541
6,7.	Cancellaria (Euclia) montserratensis Maury Height 28.5 mm, diameter 18.4 mm. USGS locality 18634. USNM 645477.	539
8.	Cancellaria (Euclia) cf. codazzii Anderson Height 37.2 mm, diameter 21.3 mm. USGS locality 21178. USNM 645478.	541
9.	Conus springvaleensis Mansfield Height 30.4 mm, diameter 14.3 mm. USGS locality 18634. USNM 645479.	544
10,11.	Conus couvaensis Vokes Height 31.7 mm, diameter 21.0 mm. USGS locality 18634. USNM 645480.	545
12-14.	Miraclathurella ralla , n. sp. 12,13. Holotype. Height 15.6 mm, diameter 4.8 mm. USGS locality 18399. USNM 645505. 14. Paratype. Height 14.1 mm, diameter 5.0 mm. USGS locality 21178. USNM 645506.	556
15,16.	Carinodrillia meraca , n. sp. Holotype. Height 17.8 mm, diameter 5.0 mm. USGS locality 21178. USNM 645499.	547

EXPLANATION OF PLATE 59

Figure	Page
1-3. Agladrillia (?) lassula , n. sp.	550
1. Paratype. Height 14.4 mm, diameter 4.3 mm. USGS locality 21178. USNM 645500. 2,3. Holotype. Height 16.4 mm, diameter 6.5 mm. Locality Hutch 47. No. H 15311.	
4. Crassispira (Crassispira) cf. caroniana (Maury)	548
Height 44.0 mm, diameter 13.7 mm. Locality PJ 285. No. H 15316.	
5,6. Crassispira (Crassispira) faceta , n. sp.	548
Holotype. Height 39.5 mm, diameter 12.2 mm. Locality RR 230. No. H 15317.	
7-10. Lepicythara disclusa , n. sp.	551
7,8. Holotype. Height 16.0 mm, diameter 7.1 mm. Locality PJ 285. No. H 15291. 9. Paratype. Height 15.3 mm, diameter 7.2 mm. Locality PJ 285. No. H 15292. 10. Paratype. Height 12.7 mm, diameter 6.7 mm. Locality PJ 285. No. H 15293.	
11,12. Crassispira (Crassispirella) ritanida (Mansfield)	549
Height 9.6 mm, diameter 4.2 mm. Locality RR 230. No. H 15301.	
13. Polystira species B	546
Height 8.9 mm, diameter 3.4 mm. Locality PJ 285. No. H 15321.	
14,15. Glyphostoma sculptile , n. sp.	557
Holotype. Height 14.0 mm, diameter 5.4 mm. Locality EL 1810. No. H 15304.	
16,17. Ithycythara hilaris , n. sp.	553
Holotype. Height 5.9 mm, diameter 2.0 mm. Locality PJ 285. No. H 15294.	
18,19. Adelocythara (?) micropleura (Guppy)	554
Height 5.2 mm, diameter 2.2 mm. Locality JS 67. No. H 15297.	





EXPLANATION OF PLATE 60

Figure	Page
1,2. Glyptaesopus species	555
Height 5.5 mm, diameter 1.6 mm. Locality JS 67. No. H 15395.	
3. Strioterebrum cf. gatumense (Toula)	558
Height 40.1 mm, diameter 10.6 mm. USGS locality 18634. USNM 645481.	
4-6. Strioterebrum aff. laevifasciola (Maury)	558
4. Height 11.4 mm, diameter 4.2 mm. Locality EL 1810. No. H 15326. 5. Height 20.5 mm, diameter 5.6 mm. Locality PJ 285. No. H 15327. 6. Height 16.4 mm, diameter 4.4 mm. Locality PJ 285. No. H 15334.	
7. Hastula aff. hastata (Gmelin)	561
Height 15.2 mm, diameter 4.3 mm. Locality RR 230. No. H 15283.	
8,9. Strioterebrum aff. baculiforme (Pilsbry and Johnson)	560
8. Height 19.6 mm, diameter 3.8 mm. Locality PJ 285. No. H 15338. 9. Height 5.5 mm, diameter 1.7 mm. Locality PJ 285. No. H 15339.	
10. Pyramidella (Longchaeus ?) species A	561
Height 10.0 mm, diameter 3.2 mm. Locality RR 230. No. H 15346.	
11. Pyramidella (Callolongchaeus) aff. jamaicensis Dall	562
Height 7.6 mm, diameter 2.4 mm. Locality PJ 285. No. H 15347.	
12. Pyramidella (Callolongchaeus) cf. diademata Maury	563
Height 5.5 mm, diameter 1.8 mm. Locality PJ 285. No. H 15353.	
13. Eulimella (Eulimella) species A	564
Height 3.1 mm, diameter 0.9 mm. Locality KR 11862. No. H 15358.	
14,15. Eulimella (Ebalina) mitis , n. sp.	565
14. Paratype. Height 3.1 mm, diameter 0.8 mm. Locality PJ 285. No. H 15363. 15. Holotype. Height 5.6 mm, diameter 1.1 mm. Locality PJ 285. No. H 15362.	
16,17. Turbonilla species A	566
16. Height 3.9 mm, diameter 1.0 mm. Locality RR 230. No. H 15366. 17. Height 3.4 mm, diameter 0.8 mm. Locality RR 230. No. H 15367.	
18. Turbonilla species B	567
Height 4.0 mm, diameter 1.3 mm. Locality EL 1810. No. H 15374.	
19. Turbonilla species C	567
Height 7.0 mm, diameter 2.1 mm. Locality JS 67. No. H 15378.	
20,21. Turbonilla species D	567
20. Height 3.8 mm, diameter 0.9 mm. Locality KR 11862. No. H 15382. 21. Height 3.9 mm, diameter 0.8 mm. Locality PJ 285. No. H 15383.	
22. Turbonilla species E	568
Height 5.0 mm, diameter 1.2 mm. Locality PJ 285. No. H 15388.	
23. Odostomia canaliculata C. B. Adams ?	568
Height 3.2 mm, diameter 1.6 mm. Locality RR 230. No. H 15355.	
24. Odostomia (Salassia ?) species	569
Height 3.0 mm, diameter 0.8 mm. Locality RR 230. No. H 15365.	
25,26. Acteocina canaliculata (Say) ?	570
Height 2.4 mm, diameter 1.3 mm. Locality PJ 302. No. H 14551.	
27,28. Cylichnella altera , n. sp.	571
Holotype. Height 2.6 mm, diameter 1.4 mm. Locality KR 11862. No. H 14550.	
29,30. Sulcoretusa aff. sulcata (d'Orbigny)	572
Height 2.2 mm, diameter 1.0 mm. Locality PJ 285. No. H 14558.	

INDEX — NO. 247

Index of genera and species.

A		affinis, Carditamera	
		(Byssomera) aff. 22	299, 357
Abra	399	Agladrillia	550
Abra ? species	300, 400	agna, Tectonatica ..	483
Acar	327	agria, Peristichia ..	564
Acmaea ..	417	agronomica, Adrana	324
Acmaea species	301, 307, 417	alabamiensis, Corbula	407
acrocosmia, Merisca	388	alatus, Typhis	493
Acteocina	570	albida, Pleurotoma	546
aculeata, Crepidula		albidum, Epitonium	
(Bostrycapulus) ..	302, 471	(Epitonium)	46 302, 459
aculeata, Patella ..	471	albuginosa, Cypraea ..	479
acuminata, Bulla ..	573	albus, Nassarius	
acuta, Crassinella	355	(Uzita) cf.	303, 519
acuticarinata,		albus, Polinices	483
Cancellaria	541	albus, Strombiformis	465
acutirostra,		alcima, Anadara	334
Tenuicorbula	414	alcimus,	
acutirostra zorritensis,		Petalconchus	445
Tenuicorbula	414	Alectryonia ..	349
adalaidis, Rhizorus	573	aliena, Cypraea	
adamsi, Anadara	336	(Erosaria)	48 302, 479
adamsi, Arcopsis .. 15	299, 311, 312, 330	altera, Cylichnella 60	304, 571
		alternata, Fissurella ..	416
adamsi conradiana,		alternata henekeni,	
Arcopsis	331	Diodora	416
adamsi sawkinsi,		alternatus, Pitar	
Fossularca		(Lamelliconcha)	311, 312, 375
(Fossularca)	330	altilira, Turritella	440
adamsi, Seila cf. 45	302, 451	altum, Teinostoma	428
adansonii, Cerithium	447	amaliense, Dentalium	
adansonii, Fossarus ..	467	(Graptacme)	13 298, 315
adanum, Glyphostoma	558	ambiguus, Turbo	467
Adelocythara	554	americana, Arca	326
Adrana	323	americanus,	
adrium, Glyphostoma	558	Modiolus cf. .	299, 342
adpersum,		Americardia	369
Calliostoma	418	amydra, Cumingia	401
aegis, Crassispira	549	amygdala, Marginella	534
aemulator, Conus ...	545	Anachis	501
Aepystoma	428	Anachis (Anachis)	
aequalis, Abra	399	species	303, 502
aequalis, Abra cf. 37	300, 399	Anadara	331
aequilibratus, Donax	403	Ancilla	529
Aequipecten	344	andrium, Teinostoma	
Aequipecten		(Aepystoma)	428
(Plagiectenium)		anomala, Narica (?)	468
species	299, 347	anomala floridana,	
aequivalvis,		Fossarus	468
Juliacorbula	39 301, 410	anomala, Hanetia	513
aequivalvis		Anomalocardia	382
stainforthi,		anomalus?, Fossarus	
Juliacorbula ..	410	(Iselica)	47 302, 468
Aesopus	505	Anomia	350
affinis, Cardita	357	Antalis	315

INDEX

antieriocosta, Semele aff.	36	300, 308, 398	austeniana maturensis, Tivela ..	372
antillarum, Dentalium		315	avunculus, Teinostoma	427
antillarum, Trigoniocardia		368	B	
antilleana, Tectonatica		483	baccata, Nucula (Lamellinucula) ..	13 299, 317
antilleanum, Teinostoma		427	Bactrospira	440
Antinioche		378	baculiforme, Strioterebrum	
antiquata, Arca		331	aff.	60 304, 560
antiquatus, Hipponix cf.	47	302, 469	Balanus	307
aotus, Cyclopecten		348	balboae, Cancellaria ..	541
apertura, Patella		416	Balcis	465
Apolymetis		393	Balcis species A	302, 466
apomsa, Moerella		385	baranoanus, Calophos	514
aquanica, Carinodrillia		547	barbadensis, Arca ..	325
arata, Carditamera		358	barbata, Arca	327
arata, Cypricardia		356	Barbatia	327
Arca		325	Barbatia species	299, 327
Architectonica		452	basteroti, Terebra	558
archon, Pecten (Pecten)	19	299, 308, 344	Batillaria	446
arcuatus, Conus		544	Batillaria species ..	43 301, 305, 446
arcularia, Buccinum ..		517	beauui, Adeorbis	431
arenaria, Serpula		444	beili, Nioche	378
Argina		336	bellastriata, Scalaria ..	461
Arginarca		336	berjadinense, Prunum	535
arionis, Caryocorbula		409	berlineriae, Strioterebrum	560
armillatum, Dentalium		314	bernardi, Condylocardia	359
arrogans, Lucina (Luciniscia)		361	bicarinata, Juliacorbula	411
Asperiscala		461	bidentata, Bulla	571
asperrima, Venus		377	bidentatus, Solen	405
asphaltoda, Anachis (Anachis)	52	303, 501	bifastigata, Turritella	436
Astraea		423	bifastigata cartagenensis, Turritella	
Astraliun		423	(Broderiptella) ..	44 301, 436
Astronacis		455	bifastigata democraciana, Turritella	436
atacata, Cylichnella ..		571	bifastigata maracaibensis, Turritella	436
athleta, Circomphalus		379	bifrons, Anadara	333
Atrina		342	billingsiana, Lunarca	16, 17 299, 306, 336
Atrina species	299, 342	420	billingsiana maturensis,, Argina	337
attrinum, Calliostoma		420	biplicata, Tellina	394
aulakoessa, Agladrillia		551	bisulcata, Architectonica	454
aurantiacus, Latirus ..		521	bisulcata, Noetia	340
auricula, Patella		473	Bittiolun	448
aurora, Psammotreta		393	Bittium	448
aurora, Tellina		392		
austeniana, Tivela (Tivela)	25, 26	300, 372		

INDEX

bocasense, Dentalium	314	bullata maiiae,	
boggsi, Hanetia	513	Marginella	
Bostrycapulus	471	(Bullata)	538
bottae, Pleurotoma	548	bullbrooki, Cancellaria	542
bowdenense,		bulloides, Globigerina	306
Trachycardium	364	burckhardti, Conus	544
bowdeniana, Arca	326	burneti, Tellina	389
Brachydontes	341	Bursa	486
Brachydontes		Byssomera	357
(Brachydontes)			
species	299, 306, 307, 341		
brasiliana, Anadara		caboblanquensis,	
(Cunearca)	299, 306, 332	Trigoniocardia	367
brasiliana,		caboblanquensis,	
Anomalocardia	30 300, 382	Trigoniocardia	
brasiliana,		(Trigoniocardia)	
Psammacoma		cf.	25 300, 367
(Temnoconcha)	395	cabopasada,	
brasiliana,		Trigoniocardia	366
Temnoconcha		Caecum	434
aff.	34, 35 300, 395	Caecum species A	301, 434
brassicus, Nassarius	518	Caecum species B	301, 435
brassoensis, Nassarius	518	Caecum species C	301, 435
brechincastrense,		Caecum species D	301, 435
Strioterebrum	559	Caecum species E	301, 435
brevifrons, Murex	491	caelata, Arca	330
brevifrons, Murex		caerulescens, Prunum	533
(Chicoreus) cf.	49 303, 491	cahuitensis,	
brevispina, Astraea		Crassinella	355
(Astraliu) cf.	42 301, 423	cahuitensis, Nucula	317
brevispina basalis,		calcareia, Tellina	391
Astraea	423	calidimaris,	
brightonensis, Arca		Parviturbo	424
(Argina)	336	californica, Maetra	383
brightonensis,		Calliostoma	418
Donax	38 300, 403	Callolongchaeus	562
brightoniana,		calothyra, Agladrillia	550, 551
Cymia	51 303, 312, 497	caloosana, Isapis	468
bristolae, Calotrophon	494	caloosana, Chama	362
broderipiana,		caloosana,	
Turritella	435	Pseudochama	
broderipiana,		aff.	23 299, 362
Turritella cf.	437	Calophos	513
Broderiptella	435	Calorhadia	321
brunnea, Natica	483	Calotrophon	494
bruscasensis,		calypsonis, Prunum	
Notocorbula	413	(Egouena)	57 304, 308, 534
buccinid indet.	54 303, 511	Calyptrea	471
bufo, Bursa		camaronensis,	
(Marsupina)	49 302, 306, 487	Lepicythara	552
bufo, Murex	487	cambiarsoi,	
bufoniopsis, Bursa	487	Strioterebrum	559
bufonius, Murex	486	cambiarsoi	
Bullata	538	nugatorium,	
bullata, Voluta	538	Strioterebrum	559
		campechiensis, Arca	336

INDEX

campechiensis, Pholas	414	carnaria, Tellina	389
camura, Malea	489	carolinae,	
canaliculata,		Trigoniocardia	25 365, 366
Acteocina	60 304, 570	caronense,	
canaliculata, Bulla	570	Teinostoma	428, 430
canaliculata?,		caroniana, Crassispira	548, 549
Odostomia	60 304, 568	caroniana, Crassispira	
canaliculata,		(Crassispira) cf.	59 304, 548
Tornatina	570	caroniana, Ancilla	
canaliculata, Volvaria	570	(Eburna)	303, 308, 529
Cancellaria	539	caroniana	
Cancellaria		springvalensis,	
(Charcolleria)		Ancilla	529
species	58 304, 542	caroniana, Chione	
cancellata, Chione		(Lirophora)	29 300, 308, 379
(Chione)	27, 28 300, 376	caroniana,	
cancellata, Metula	516	Pleiorytis	38 300, 308, 406
cancellata,		caronianum,	
Metula aff.	55 303, 515	Calliostoma	41 301, 308, 419
Cancilla	530	caroniense,	
candeana, Trochita	472	Teinostoma	
candeanum,		(Aepystoma)	43 301, 428, 430
Epitonium		cartagenensis,	
(Asperiscala) cf.	46 302, 462	Turritella	436
candida, Barbatia		Caryocorbula	407
(Barbatia)	14 299, 327	Caryocorbula	
candida, Tellina	391	(Caryocorbula)	
canrena, Natica		species	39 300, 409
(Naticarius)	302, 308, 480	Caryocorbula sp.ind.A	409
canrena, Natica		Caryocorbula sp.ind.B	409
(Naticarius) aff.	48 302, 481	cassidiformis,	
Cantharus	511	Cancellaria	539, 540
Cantharus		casta, Trigoniocardia	366
(subgenus ?)		catenulatus, Modulus	452
species A	54 303, 512	catharia, Carditamera	357
caparona, Polinices	483	caudata, Ranella	491
carchedonius,		cayenensis,	
Modulus	302, 452	Diodora	41 301, 306, 307,
Carditamera	355		416
Carditamera		cebus, Tagelus	406
(Carditamera)		centenaria,	
species	22 299, 357	Petricola	406
caribaea,		centralis, Calyptraea	302, 308, 471
Caryocorbula	408	centralis,	
caribaea pergrata,		Calyptraea cf.	472
Caryocorbula	408	centrota, Noetia	
caribbaea, Tritonalia		(Eontia)	18 299, 339
(Ocinebrina)	496	ceramida,	
caribbeana,		Trigoniocardia	368
Conomitra	532	ceramida,	
caribbeanum,		Trigoniocardia aff.	368
Calliostoma	419	cerata, Nuculana	321
Carinodrillia	547	cercadensis,	
Carinodrillia? sp.ind.	548	Nassarius	519
carnaria?, Strigilla		cercadensis,	
(Strigilla)	33 300, 389	Pyramidella	563

INDEX

cercadica, Lepi- cythara	552	clementia, Crassinella	354
cercadica,		cleryana, Mulinia	384
Temnoconcha	395	coarctata, Cumingia ..	401
Cerithiopsis	449	cochlearis,	
Cerithiopsis		Solenosteira	512
(Cerithiopsis)		Cochliolepis	430
species	45	cocosensis, Phos	515
Cerithiopsis	301, 449	codazzii, Cancellaria ..	
(subgenus ?)		(Euclia) cf.	58
species	302, 451	codensis,	
Cerithium	447	Aequipecten	346
cestrota, Calorhadia ..	322	cognata, Temnoconcha ..	395
cetolaca, Mangilia	555	collina, Marginella	536
Chama	361	collinsii, Trochita	472
Chama spec.ind.	299, 362	colombiensis,	
Charcolleria	542	Apolymetis	393
Cheilea	469	colombiensis, Metis ..	393
chelonina, Phos	515	Colubraria	485
chemnitzii, Anadara ..	333	Colubraria species	302, 485
chemnitzioides,		Columbella	498
Anadara	334	colus, Murex	523
Chicoreus	491	commutata, Leda	319
chiloensis, Pholas	414	comparilis, Pecten	345
chinensis, Patella	471	compsa, Diodora	417
Chione	376	concentrica, Venus	370
Chione (Lirophora) ..		concentrica prosapia, ..	
species	30	Dosinia	371
Chione (Lirophora) ..	300, 380	concinna, Cytherea ..	374
sp.ind.	379	concinna,	
Chionopsis	378	Temnoconcha	395
chipolanum,		concinus, Pitar	376
Crucibulum	474	Condylocardia	358
chrysalloideus,		coniformis,	
Aesopus	506	Marginela [sic]	534
chrysostoma, Murex ..		Conomitra	531
(Murex)	49	Conomitra	
cicerula, Strigilla	302, 489	species A	55
Cinctriforma	390	consensus, Nassarius ..	303, 532
cinctum, Prunum	458	Conus	519
cingenda, Venus	535	Conus species	543
cinnamomea, Ancilla ..	376	Conus species	304, 545
circinatus, Pitar	529	corbicula, Venus	372
(Lamelliconcha) ..		cornucopia, Patella	469
26, 27 300, 311, 312, ..		cornurectus, Murex	491
374		Cosmotriphora	458
345		costaricensis,	
circularis, Pecten	346	Lepicythara	552
circularis, caucanus, ..		costaricensis,	
Pecten	346	Semele cf.	397
clavata, Eulima	302, 464	costata, Arca	336
clavata, Pholas	415	costellata, Calorhardia ..	
clavatulata, Cancellaria ..	541, 542	(Calorhardia)	311, 322
clavium, Teinostoma ..	430	costellata, Nucula	321
clavulus, Strombina ..	508	Costelloleda	321
claytoni, Semele	398	Costoanachis	503
claytoni couvensis, ..		costulata, Turbonilla ..	566
Semele	36	costulata, Turritella ..	451
300, 308, 398		costulatus, Trochus	423

INDEX

couvaensis, Conus	58	304, 308, 545	Cymatium species	302, 485
couvaensis, Tellina		391	Cymia	311, 497
couvana, Cancellaria ..		539	Cymia species	303, 498
couvana, Oliva			Cypraea	478
(Oliva)	56	303, 308, 525	Cypraea species	48 302, 306, 478
couvense,			cypraeola, Voluta	476
Trachycardium		364	Cythara sp.ind.	552
couviana, Persicula				
(Rabicea)	57	304, 308, 536		D
coxi, Glyptaesopus		555		
crasicardo [sic]			Dactylidia	527
Pecten		344	dactylus, Pholas	414
crassa bowdenensis,			dalli, Anachis	502
Bursa		488	dalli, Eulima	464
crassa colombiana,			dali, Strombiformis	
Bursa		488	sp.ind.aff.	464
crassa proavus,			dalliana, Chione	377
Bursa		488	dalliana guppyana,	
crassidens, Pandora ..		416	Chione	377
crassilabrum,			dalliana veatchiana,	
Strombina			Chione	377
(Sincola)	53	303, 508	dalliana, Leda	323
Crassinella		352	dallianum, Prunum	
crassinoda,			(Prunum)	57 304, 533
Fasciolaria		523	Dallocardia	363
Crassispira		548	dama, Voluta	526
Crassispirella		549	daphnis,	
Crassostrea		349	Caryocorbula	408
crassula, Eulimella		564	deadenensis,	
crassus, Murex		487	Trigoniocardia	367
Crepidula		470	decaptyx, Cancellaria	542
Crepidula sp.		302, 470	decipiens,	
cristagalli, Mytilus		349	Calliostoma	41 301, 418
cristata, Tellidora		389	decipiens	
cristella, Chama		362	laticarinatus,	
cristobalcoloni, Oliva		525	Trochus	419
Crucibulum		473	decussatus,	
crystallina, Tellina		387	Serpulorbis	43 301, 444
cubaniana, Corbula		410	defuniak, Cyclopecten	348
Cucullaearca		327	delicatus, Asaphis	406
cultellata, Chione		380	demiurgus,	
Cumingia		400	Aequipecten	
Cunearca		332	(Plagiectenium)	20 299, 308, 345
cunninghamcraigi,			democracianum,	
Strombina		509	Prunum	534
curtum, Prunum		533	densata, Plicatula	343
Cyclinella		371	densecostata, Malea ..	489
Cyclinella (?) species		300, 372	Dentalium	313
Cyclopecten		347	Dentalium	
Cyclopecten species ..		299, 348	(Dentalium) species	298, 314
Cyclostremiscus		431	Dentalium	
Cyclostremiscus			(Laevidentalium?)	
(Ponocyclus) species		301, 432	species	298, 315
Cylichnella		571	dentiferum,	
Cylichnella species		305, 572	Glyphostoma	557
cylindrica, Oliva		525	deplanatum,	
Cymatium		485	Astralium	423

INDEX

depressa, Delphinula	432	ebergenyii, Chione	382
dextroversus,		eboreum, Dentalium	315
Triphoris	451	Eburna	529
diademata,		eburnea, Niso	466
Pyramidella		eburnea, Nuculana	320
(Callolongchaeus)		ectyphus, Calophos	513, 515
cf.	60	ecuadoriana,	
dichotoma, Strigilla	304, 563	Temnoconcha	395
Diodora	390	ecuadorianum,	
Diodora (?) species	416	Teinostoma	427
disclusa,	301, 307, 417	edulis, Ostrea	348
Lepicythara	59	Egouena	534
discus, Dosinia	304, 308, 551	egregia, Balcis	47
disparile, Dentalium	371	egregia, Calorhadia	302, 308, 465
disparilis,	315	elephantinum,	323
Notocorbula aff.	40	Dentalium	313
Disputaea	301, 412	elinguis, Moerella	
divisus, Solen	474	(Moerella)	31
divisus, Tagelus	405	emersoni, Cerithiopsis	300, 384
(Mesopleura) cf.	300, 405	(subgenus?)	45
divulgatum,		emersonii	302, 450
Dentalium		persubulata,	
(Dentalium)	13	Certhiopsis	
dolabratus, Trochus	298, 313	(Laskeya)	450
dombei, Psammotreta	561	Emmonsella	543
domingensis, Barbatia	393	entemna,	
(Acar)	15	Miraclathurella	556
domingensis, Erato	299, 328	Eontia	339
domingensis trochala,	477	ephippium, Anomia	350
Erato	477	Epitonium	459
domingensis,		equestris, Cheilea cf.	302, 469
Petalocochus	445	equestris, Patella	469
donacina, Tellina	384	Erato	476
Donax	401	Erato sp.	476
Donax		erosa, Cypraea	479
(Machaerodonax?)		Erosaria	479
species	37	erythraeonense,	
dorsata, Strombina	300, 404	Cerithium	447
dorsenula, Diodora	508	esmeralda, Anadara	333
dosin, Chama	417	esmeraldensis,	
Dosinia	370	Gordanops	514
Dosinia (Dosinia)	370	esmeraldus, Fusinus	524
species	300, 371	estrellensis,	
Dosinidia	370	Strombinophos	510
draconis,		Euclia	311, 539
Pseudochama	363	eucosmius, Fusinus	524
dupontiae, Conus	499	Eucrassatella	351
dupontiae,		euglyptum,	
Parametaria	312, 500	Calliostoma	419
dupontii, Conus	499	Eulima	463
durhamianum,		Eulima species A	46
Epitonium	463	Eulimella	302, 464
dysera, Venus	376	Eulimella (Eulimella)	564
		species A	60
		Eupleura	304, 564
		euprepes,	491
		Architectonica	454
Ebalina	565		
ebenina, Crassispira	550		

E

INDEX

europaea, Cypraea	477	florius, Fossarus	468
europaeum, Cardium	370	foliaceicostum,	
eurybis,		Epitonium	
Architectonica	453, 456	(Epitonium) aff.	302, 459
Eurytellina	385	foliaceicostum,	
eutykta, Strigilla	391	Epitonium cf.	460
Euvola	344	fontainei, Nassa	520
euzonus, Solariorbis	434	fornicata, Crepidula	470
exigua, Nucula		fornicata, Patella	470
(Lamellinucula)	312, 317	Fossarus	467
exilis, Nassarius	520	fragilis, Arca	319
exoleta, Turritella	440	francescae,	
exoptata, Adrana	325	Parviturbo	424
extricata, Nuculana	320	fraudans, Anachis	
exustus, Brachydontes	342	(Costoanachis)	53
exuvioides?, Nerita		fretense, Bittium	303, 504
(Nerita)	42 301, 305, 424	(Bittium)	45
		freya, Bursa	301, 448
F		fucus, Murex	488
fabagella, Donax	402	Fugleria	496
fabagelloides,		fulgurans, Nerita	328
Donax	37, 33 300, 402, 404	fundarugata, Olivella	425
faceta, Crassispira		(Miniolella)	55
(Crassispira)	59 304, 548	fuscescens,	303, 528
falconensis, Metis	393	Crassispira	550
fargoi, Nassarius	520	fusidens, Anachis	503
fasciata, Melongena	521	fusiformis, Polygona	521
Fasciolaria	522	Fusinus	523
fausta, Lucina		Fusinus species	56
(Luciniscia)	361	fusoides, Mitra	303, 523
felix, Moerella	385	Fusus	531
felix, Tellina			523
(Eurytellina) cf.	385		
femorale, Cymatium	485	G	
femorale, Murex	485	gabbi, Cylichnella	571
filicata, Anadara	333	gadsdenensis, Nucula	317
filicata, Anadara		galbana,	
(Cunearca) aff.	15 299, 333	Psammotreta	34
fischeri, Rissoina	426	galbanus, Nassarius	300, 392
Fissurella	417	(subgenus?)	55
flabellatus,		galbensis,	303, 520
Pectunculus	341	Cumingia	37
flavida, Eburna	529	galbensis,	300, 400
flavum, Cerithiopsis	450	Risomurex	50
flexuosa, Venus	382	galvestonense,	303, 495
florencae, Polystira	546	Bittium	449
floridana,		galvestonensis,	
Carditamera	357	Strigilla	391
floridana, Trochita	473	gatonense,	
floridana, Urosalpinx	494	Strioterebrum	558
floridanus,		gatonense,	
Petalocochus	446	Strioterebrum	
floridanus,		cf.	60
Petalocochus aff.	446	gatonense kugleri,	304, 558
floridanus,		Strioterebrum	558
Petalocochus		gausapatum	
aff.	43 301, 445	laevifasciola,	
		Strioterebrum	559

INDEX

gavilanensis, Hanetia	513	guadalupensis,	
gemmatum, Triphora	457	Crassinella	353
georgiana, Strigilla	391	guadelupensis,	
gibberula, Strombina	509	Pallacera	517
gibberula		guadelupensis,	
galvestonensis,		Pallacera aff.	517
Strombina	509	guadelupensis,	
gibbosa, Plicatula	19 299, 343	Pallacera cf.	303, 517
gibbulus, Murex	521	guaymasensis, Semele	399
gibbus, Aequipecten		gubernaculum,	
(Plagiactenium)		Psammotreta	393
cf.	19 299, 345	guinensis, Solen	404
gibbus demiurgus,		guppyana, Chione	377
Chlamys		guppyi,	
(Plagiactenium)	345	Architectonica	
gibbus, Solen	404	(Pseudotorinia)	302, 454
gigantea, Venus	373	guppyi, Brachydontes	341
glaber, Strombiformis	464	guppyi, Carditamera	
glabrata, Ancilla	530	(Carditamera)	22 299, 356
glabrata speciosa,		guppyi,	
Ancilla	530	Condylocardia	23 299, 358
glabratum, Buccinum	529	guppyi, Crassinella	22 299, 354
Globigerina	306	guppyi plana,	
Globigerinoides	306	Crassinella	354
globularis, Cantharus	512	guppyi radiata,	
Glycymeris	340	Crassinella	354
glycymeris, Arca	340	guppyi, Cyclopecten	348
Glyphostoma	557	guppyi, Leda	323
Glyptaesopus	555	guppyi, Plicatula	343
Glyptaesopus		guppyi,	
species	60 304, 555	Trigoniocardia	368
glyptocyma, Venus	379	gurabensis,	
golfoyaquense,		Nassarius	518
Glyphostoma	557	guttata, Triphora	46 302, 458
Gordanops	514		
gouldiana, Pandora	416		
gracilis, Carditamera	358		
gracilis, Donax	403		
gradata, Arca	327		
graeca, Patella	416		
grandis, Dosinia			
(Dosinia)	300, 308, 311, 370		
grandis?, Niso	302, 466		
grandis, Niso			
sp.ind.aff.	467		
granifera,			
Trigoniocardia	369		
graniferum, Cardium	365		
granosa, Fasciolaria	523		
granti, Notocorbula	413		
granulata, Colubraria	485		
granulata, Ranella	487		
granulatus, Trochus	419		
granulosa, Mitra	531		
Graptacme	315		
gryphoides, Chama	361		

INDEX

hastata mareana,		inaequilateralis,	
Hastula	561	Anadara	332
Hastula	561	inaequilateralis,	
helecteroides, Aclis	463	Anadara (Anadara)	
helenae, Caryocorbula		aff.	299, 331
(Caryocorbula)		inaequivalvis, Arca	334
38, 39	300, 407	inaequivalvis, Tellina	415
Heliacus	455	inca, Rissoina	426
helikum, Epitonium ..	461	incertum, Dentalium	315
heliotropium,		incongrua, Arca	332
Trochus	423	incrassata?, Nassa	519
henekeni, Crassispira ..	548	indecisa, Anomia	351
henekeni, Fissuridea ..	416	infundibulum,	
henekeni, Fusinus cf. 303, 306,	524	Latirus	
henikeri, Fusinus	524	(Polygona) cf.	303, 308, 521
hepatica, Albula	483	infundibulum polius,	
heptagona,		Latirus	522
Lepicythara	552	infundibulum cf.	
heredium,		polius, Latirus	522
Trigoniocardia	367	infundibulum, Murex	521
hermosus, Triptychus ..	564	intastriata, Metis	394
Hertellina	387	intermedia, Balcis	466
hertleini, Odostomia ..	569	interrupta,	
heterogena,		Marginella	536
Notocorbula	411	interrupta mareana,	
hilaris,		Persicula	537
Ithyocythara	59	interruptolineata,	
hilli, Pitar	304, 553	Persicula	
hindi, Anadara	376	(Rabicea) cf.	57
hindsii, Metula	333	interruptolineata,	304, 537
hindsii, Metula	515	Voluta	536
Hipponix	469	ira, Juliacorbula	411
hodsoni, Persicula	537	isabella, Mitra	530
hubbardi, Tagelus	405	isabellae, Cerithium ..	447
humphreysi?,		Isapis	467
Epitonium		Iselica	467
(Epitonium)	46	islahispaniolae,	
hutchisoni,		Parametaria	501
Calotrophon (?)	303, 494	islatrinitatis,	
hybrida, Macoma	392	Notocorbula	40 301, 308, 411
hyptius anebus,		isocardia, Cardium	363
Solariorbis	433	Ithyocythara	552
		Ithyocythara species ..	304, 553
I			
illecta, Leda	319	J	
illota, Barbatia	330	jacksonensis,	
imbricata		Cylichnella	571
imbricata, Arca	14	jamaicensis,	
(Arca)	299, 326	Pyramidella	
imitator, Conus	544	(Callolongchaesus)	
imitator lius, Conus ..	544	aff.	60
immunita, Neosimnia ..	480	jamaicensis,	304, 562
imperialis, Trochus ..	423	Pyramidella	
imperialis var. a,		(Longchaesus)	562
Murex		jamaicensis, Venus ..	360
(Phyllonotus)	490	japonicus, Aesopus	505
inaequalis, Pecten	345		

INDEX

jaspidea, Voluta	526	Latirus	521
Jaspidella	526	lavelana, Conomitra ..	532
jaspideus, Conus	546	laxa, Odostomia	
jujubinum,		(Salassiella)	569
Calliostoma	421	leana, Semele	398
Juliacorbula	410	leander, Marginella ...	536
		ledaeformis,	
		Cercomya	323
K		lehneri, Eupleura 50	303, 491
kelumni, Ithycthyra	553	lena, Thais	496
kingicola,		Lepicythara	551
Crassatella	351	lepta, Acteocina	571
knoxiana, Corbula	410	leptalea, Nuculana ...	319
knoxiana fossilis,		leroyi, Springvaleia ..	294, 301, 308,
Juliacorbula	410		440
kugleri, Cymatium ...	485	leroyi secunda,	
kugleri, Eupleura	493	Springvaleia	441
kurzi, Adrana	324	liana, Lucina	
		(Lucinisca)	361
L		limonensis, Metula ...	516
labreana, Columbella	503	lineatus, Tagelus	406
labreanus, Pitar		linter, Metula	516
(Lamelliconcha) 27	300, 375	liogona, Dosinia	370
Laevicardium	369	lipara, Delphinula ...	431
Laevidentalium	315	lipara, Sulcoretusa ...	572
laevifasciola,		liriope, Circulus	433
Strioterebrum		Lirophora	379
aff. 60	304, 558	lloydi, Anadara	333
laevigata, Odostomia	568	Longchaeus	561
laevigatum,		Lopha	349
Laevicardium cf.	300, 370	lordlyi, Cerithium	564
laevis, Semele	311, 312, 397	loripanus,	
laevis costaricensis,		Strombinophos	510
Semele	36 300, 311, 312,	Lucina	359
	397	Lucinisca	360
lamelata,		luctuosa, Pleurotoma	549
Ancilaria [sic]	529	ludificans, Nuculana	
Lamelliconcha	374	(Saccella)	13 299, 319, 321
Lamellinucula	316	Lunarca	336
lamellosa, Cumingia ..	400, 401	lumbricalis, Serpula ..	441
lanceolata,		lumbricalis, Vermetus	442
Colubraria	485	lunulata, Crassinella	355
lanceolata,		lunulata, Tellidora ..	389
Columbella	507		
lanceolata, Nucula		M	
(Adrana)	323	macerophylla,	
Laskeya	451	Chama cf. 24	299, 362
lassula,		macescens, Mactra ...	383
Agladrillia (?) 59	304, 550	macescens,	
lateralis, Mactra	383	Mactra aff.	383
laticarinatum,		Machaerodonax	404
Calliostoma	41 301, 419	mackiana, Pholas 40	414
latilabris, Malea	489	Macoma	391
latilirata, Chione		Macoma	
(Lirophora)	380	(Psammacoma)	
latilirata, Venus	379	species A	34 300, 308, 391

INDEX

Macoma					
(Psammacoma)					
species B	34	300, 392			
Macrocallista		373			
macrodon, Venus		382			
Macrophragma		446			
Mactra		382			
mactroides, Trigona		372			
mactroides, Venus		372			
maculata,					
Macrocallista	300, 308, 373				
maculosa, Crepidula					
(Crepidula) cf.	47	302, 470			
magdalenensis,					
Hanetia		513			
maiae, Bullata	57	304, 538, 539			
maiguettiana,					
Olivella		529			
maiguettiana,					
Turritella		439			
Malea		311, 489			
Malea species		302, 489			
mamillaris, Natica		483			
mammata, Bursa		486			
mansfieldi, Tagelus					
(Mesopleura?)	300, 308, 405				
manzanillaensis,					
Conus		545			
manzanillensis,					
Trigoniocardia		366			
maracaibensis, Mactra					
(Micromactra)					
cf.	30, 31	300, 383			
marcottae, Nioche		378			
mareana, Cylichnella		572			
mareana, Odostomia		569			
marella, Calorhadia		322			
marensis, Donax		402			
margarita, Merisca		388			
margaritensis, Murex					
(Phyllonotus)		490			
marginata, Plicatula		343			
marginatus,					
Solariorbis					
(subgenus?)	43	301, 432			
marmoreus, Conus		543			
Marsupina		487			
Martesia		415			
martinicensis,					
Crassinella	22	299, 352			
martinicensis,					
Merisca		388			
martschi, Peristichia		564			
Mathilda		456			
Mathilda species		457			
Mathilda species A	46	302, 456			
Mathilda species B		302, 457			
maturrense, Cardium					365
maturrense, Epitonium					
(Epitonium)	46	302, 460			
maturrensis,					
Aequipecten					
(Plagiectenium)	20	299, 346			
maturrensis,					
Aequipecten					
(Plagiectenium) cf.		299, 347			
maturrensis,					
Bullata	58	304, 306, 538			
maturrensis,					
Parviturbo	42	301, 424			
maturrensis,					
Trigoniocardia					
(Trigoniocardia)	25	299, 365			
maugeriae, Erato	48	302, 476			
mauryae, Conomitra		532			
mauryae, Turritella		438			
maxima, Ostrea		343			
maximus, Pecten		344			
maxwelli,					
Strombinophos		510			
mazatlanicus,					
Heliacus		454			
medium, Cardium		369			
megodon, Ostrea		349			
Meloceras		435			
melajoense,					
Teinostoma					
(Aepystoma)	43	301, 429			
melajoensis,					
Architectonica					
(Pseudotorinia)	46	302, 453, 455			
melajoensis,					
Eurytellina	32	300, 386			
melajoensis,					
Strombina					
(subgenus?)	53	303, 507			
melajoensis,					
Tenuicorbula	40	301, 413			
melajoensis,					
Tenuicorbula					
aff.	40	301, 414			
melajoensis,					
Trigoniocardia					
(Trigoniocardia)	25	300, 308, 366			
melanura, Triphora		458			
melina,					
Crasatela [sic]		351			
Melongena		520			
melongena,					
Melongena	56	303, 521			
melongena, Murex		521			
meraca,					
Carinodrillia	58	304, 547			
Merisca		387			

INDEX

Mesopleura	405	Mulinia species	31	300, 383
messor, Lopha	21	299, 349	multangulus,	
Meta	498	Cantharus		512
Metaphos	515	multistriatum,		
Metaphos (?)		Epitonium		
species	54	(Asperiscala)		
metcalfei,	303, 515	cf.	46	302, 461
Aesopus aff.	53	Muracypraea		478
Metula	303, 507	Murex		489
311, 515		muricata, Lucina		360
metula, Buccinum	515	muricatum, Cardium ..		363
mexicana, Crassinella	353	muriciformis,		
meyeri, Tellina	393	Eupleura		492
Microgaza	422	muricoides,		
Micromactra	311, 383	Risomurex		496
microleura,		mus, Cypraea		478
Adelocythara (?) 59	304, 554	musacina,		
midensis, Crassinella	355	Agladrillia		551
migum, Buccinum	518	mutica, Oliva		527
miliun, Parviturbo	424	mutica, Olivella		527
millifila, Barbatia	329	mutica, Olivella		
millifila latrinidadis,		(Dactylidia) aff. 55		303, 527
Barbatia		myakkanus, Rictaxis ..		570
(Fugleria?)	14	328	myrakeenae,	
mimetes, Turritella	437	Glyphostoma		558
mimetes, Turritella		myrasticata, Nassa		516
(Broderiptella)		myrmecoon, Aesopus ..		505, 506
aff.	44	myrmecoon, Olivella ..		528
301, 437, 439				
mimicus,				
Strombophos	510			
minima, Batillaria	446			
minima, Cardita	356			
Minioliva	528			
minuta, Porphyria	527			
mira, Anachis	504			
Miraclothurella	556			
mitis, Eulimella				
(Ebalina)	60			
304, 565				
mitra, Acmaea	417			
Mitrella	508			
mitrella, Voluta	356			
mixteca, Calophos	514			
modesta, Triphora	458			
Modiolus	342			
modiolus, Mytilus	342			
Modulus	452			
modulus, Trochus	452			
Moerella	384			
Moerella (Scissula)	387			
monolirata, Eulimella				
(Ebalina)	565			
montagui, Balcis	465			
montserratisensis,				
Cancellaria				
(Euclia)	58			
304, 308, 539				
montserratisensis,				
Eucrassatella	352			
Mulinia	383			

N				
Narona	311, 541			
Nassarina species	505			
Nassarius	517			
Nassarius (Uzita)				
species A	55			
303, 519				
nassula, Lucina	360			
nasuta, Tivela	373			
nasuta austeniana,				
Tivela	372			
nasuta maturensis,				
Tivela	372			
Natica	480			
Naticarius	480			
nelsoni,				
Aequipecten	346			
Neosimnia	479			
Nerita	424			
Neritina	425			
neritoideus, Murex	496			
nicoyana, Tellina				
(Scissula)	387			
nigra, Pinna	342			
nimbosa, Venus	373			
Nioche	377			
Niso	466			
Niso species	302, 467			

INDEX

Niteolina		527	Olivella		526
nitida, Marginella		536	olivella, Macoma		391
nivea, Olivella		527	Olivella (Olivella)		
niveus, Obeliscus			species	55	303, 526
(Triptychus)		563	olssoni,		
noae, Arca		325	Calliostoma	42	301, 421
nobilis nobilis,			opercularis, Chlamys		344
Architectonica			orbicella, Nucula		318
(Architectonica)	45	302, 308, 452	orbicularis,		
nodosa, Nerita		496	Glycymeris		340
nodulosa,			oreodoxa, Turritella		436
Scabricola	55	303, 531	oryza, Rictaxis		570
Noetia		311, 338	Ostrea		348
nonurum, Calliostoma		419	Ostrea species		299, 348
norvegicum, Cardium		370	ostrearum, Murex		495
Notocorbula		411	ovalis, Arca		336
Notocorbula			ovata, Pleiorytis		406
species	40	301, 412	ovuloides, Meta		499
Notovola		344	ovumlacerti,		
novaezelandiae,			Cylichnella		571
Pecten		344	oxytatus, Rhizorus		573
nucleus, Arca		316			
nucleus, Pecten		345		P	
Nucula		316			
Nuculana		319	pacifica, Crassinella		353
nugax, Teinostoma			pagodus, Cantharus		511
(Pseudorotella)	43	301, 427	Pallacera		516
nupera,			Pallacera		
Architectonica		453	species A	55	303, 516
			pallida, Mulina		384
O			panamensis, Nassa		520
			panamensis, Strigilla		390
obesa, Anachis			panamensis,		
(Costoanachis)	52	303, 503	Vitrinella		431
obliquus, Solen			panamica,		
(Solen)	38	300, 407	Pseudoneptunea		512
oblita, Microgaza	42	301, 422, 455	Pandora		415
obtusum, Solarium		453	Pandora species		301, 415
occidentalis, Arca		325	paphia, Chione		380
occidentalis miocica,			papulosus,		
Arca		326	Serpulorbis		444
Odostomia		568	paramegodon, Loph		350
Odostomia (Salassia?)			Parametaria		311, 498
species	60	304, 569	parasitica,		
oedalium,			Cochliolepis		430
Trachycardium		364	pariaensis, Lunarca		337
oedalium harveyense,			parva, Thetis		353
Trachycardium		364	Parviturbo		423
oertli, Crassispira		550	patula, Melongena		521
oligocenica,			pauliana,		
Martesia	40	415	Condylocardia		358
oligolepis,			paytensis, Pitar		375
Cyclopecten		348	Pecten		343
oligosculata,			pecten, Murex		489
Eurytellina?	33	300, 386	pectinata, Lucina		
Oliva		524	(Lucina) cf.		299, 306, 360
oliva, Voluta		525	pectinata, Tellina		360

INDEX

pectinata,			pisiformis,		
Tucetona cf.	299, 341		Strigilla		
peculiaris,			(Pisostrigilla) ..	33	300, 390
Aesopus	53	303, 312, 505	Pisostrigilla		390
peloronta, Nerita		424	Pitar		374
pentagonus,			pittieri, Anadara		333
Cyclostremiscus			placata, Anadara		
(Ponocyclus)	43	301, 431	(Scapharca)	16	299, 335
perattenuata,			Plagioctenium		345
Turritella		440	plana, Crepidula	47	302, 470
perdiciania,			plana triangula,		
Cancellaria			Crepidula		470
(Charcolleria)		542, 543	planigyrate,		
perdoctus,			Turritella		
Strombinophos	53	303, 510	(Broderiptella)	45	301, 308, 437
periimaris,			planigyrate,		
Trigoniocardia			Turritella		
(Americardia)		369	(Broderiptella)		
Peristichia		563	aff.	45	301, 439
perlamellosa,			planiliratus, Conus		544
Semele		398	planispira, Heliacus ..		455
perlepidia,			planum, Crucibulum ..		473
Nuculana			plebeius, Tagelus		
(Saccella)	13	299, 320	(Tagelus)		300, 404
pernula, Mya		319	Pleiorytis		406
perornatus,			Pleuroploca		522
Systemomphalus		433	plexita, Mathilda		457
perplexa, Olivella			plicata, Arca (Acar) ..		328
(Minioliva)		528	Plicatula		343
perplexabilis, Meta ..		500	plicatus, Turbo		568
perprotracta?,			plicomphalus,		
Adrana	14	299, 323	Calliostoma	41	301, 420
Persicula		536	plicosa, Mangilia		554
persicula, Voluta		536	pliocena, Triptychus ..		564
persimilis,			pluscita,		
Acteocina		570	Cochliolepis	43	301, 430
perspectivus,			podagrimum, Bittium ..		448
Trochus		452	poecila, Nassarina		
peruvianus, Tagelus ..		406	(Zanassarina)		505
Petaloconchus		444	Polinices		483
pexata, Arca		336	Polinices species		302, 484
pharcida,			politum, Teinostoma ..		427
Calorhadia		322	Polygona		521
pharcida, Leda		321	polynematicus,		
phoinicoides,			Murex		490
Rhizorus		573	polyphragma,		
Pholas		414	Serpulorbis		444
Pholas species	301, 306,	414	Polystira		546
Phrontis		517	Polystira species A ..		304, 546
Phyllonotus		490	Polystira		
picata, Columbella		498	species B	59	304, 546
piliferum,			pomum, Murex		491
Crucibulum			pomum, Murex		
(Crucibulum)	47	302, 312, 475	(Phyllonotus) cf.		303, 306, 490
piliferum,			ponderosa, Arca		339
Crucibulum cf.		476	ponderosa, Dosinia		
pilsbryi, Teinostoma ..		430	(Dosinia)		311, 371

INDEX

Ponocyclus	431	punicea,	
popenoi, Bullata	538	Eurytellina cf.	386
praevoidens		punicea?,	
rioecanus, Xancus	532	Eurytellina	32 300, 385
prenucia,		punicea, Tellina	385
Notocorbula	411	puntagordensis,	
pressa, Tellina		Notocorbula	413
(Angulus)	385	Purpura	
primolevis,		sp. indet.	496
Adelocythara	554, 555	purpurascens,	
problematica,		Semele	35 300, 396, 399
Cypraea	478	purpurata, Oliva	526
proctorae,		pusilla,	
Glyptaesopus	555	Tectonatica	48 302, 482
proficua, Semele	35 300, 396	pusio, Conus	546
profundorum,		pustulosus, Pecten	348
Crassinella	355	Pusula	477
propefusiformis,		pycnium, Teinostoma	428
Carinodrillia	547	Pyramidella	561
propeobesa,		Pyramidella	
Marginella		(Longchaeus?)	
(Persicula)	537	species A	60 304, 561
properatum,		pyrum, Voluta	532
Bittium	449		
properegulare,			Q
Caecum	434	quadragenarium,	
prosulcata,		Cardium	363
Sulcoretusa	572	quadratus, Typhis	493
proteus, Conus	545	quadratus, Typhis	
prototypus,		(Typhinellus)	
Parametaria	51, 52 303, 308, 499, 501	cf.	50 303, 493
Prunum	533	quadricarinatus,	
prunum, Voluta	533	Turbo	456
Psammacoma	391	quentinensis, Semele	399
Psammotreta	311, 392	quirosana, Strombina	508
Psammotreta sp.	393	quitanensis, Adrana ..	324
Pseudochama	362		
pseudoillota,			R
Barbatia		Rabicea	536
(Fugleria)	328, 329	radians, Cypraea	477
Pseudorotella	427	radians, Trivia	
Pseudosalpinx	494	(Pusula)	312
Pseudotorinia	453	radians orientalis,	
psila, Mangilia	553	Trivia (Pusula)	48 302, 312, 477
pulcher,		radians, Pseudochama	362
Petalocochus	445	radians, Trochita	47 302, 312, 473
pulchra, Semele	399	radians, Trochita cf. ..	473
pulligera, Nerita	425	radicula,	
punaensis, Donax	403	Vermicularia cf.	442
punctata,		ralla,	
Pyramidella	561	Miraclathurella	58 304, 556
punctatum,		ramosa, Plicatula	343
Cerithiopsis	450	ramosus, Chicoreus ..	491
punctocaelata,		rata, Ithycthyra	553
Tornatella	569	reeds, Chlamys	
		(Plagiocentrum)	345

INDEX

regulare, Caecum	435	Salassiella	569
rehderi, Parviturbo ..	423, 424	salinae, Olivella	529
reticulata,		salmo, Fasciolaria	523
Barbatia (Acar)	328	sanctiandreae,	
reticulata, Tellina	396	Scapharca	
reticulata, Voluta	539	(Cunearca)	332
reticulatus, Murex	448	sanctidavidis,	
reversa, Noetia	339	Anadara	
Rhizorus	573	(Scapharca?)	15 299, 334
Rhizorus species A ..	305, 573	sanctidavidis, Chione	
Rhizorus species B ..	305, 573	(Liophora)	30 300, 381
Rictaxis	569	sanctidavidis,	
Rictaxis species ...	304, 570	Trachycardium	
ringens, Cassis	489	(Dallocardia)	24 299, 363
riomaturensis,		sanctidominici,	
Chione (Liophora) ..	380	Jaspidella	55 303, 308, 526
riosecana,		sanctifrancisci,	
Turbinella	304, 308, 532	Cancilla cf.	303, 308, 530
Risomurex	495	sanctipauli,	
Rissoina	426	Condylocardia	358
Rissoina (Rissoina)		sanctus, Aesopus	505, 506
species	301, 426	Scabricola	531
ritanida, Crassispira		scalare, Epitonium	459
(Crassispirella) ..	59 304, 549	scalarina, Columbella	501
rohri, Calophos	54 303, 308, 514	scalaris, Turbo	459
rohri, Epitonium		scalpellum, Donax	404
(Asperiscala)	46 302, 462	Scapharca	334
roigi, Lucina	23 299, 360	schultzana, Lunarca ..	337
(Lucinisca)		scillae, Melania	564
roseus, Risomurex ..	495	scissa, Ithythythara	553
rostrata, Arca	319	sculptile,	
rotella, Callogaza		Glyphostoma	59 304, 557
(Microgaza)	422	sculpturatus,	
rotella vetula,		Petalocochus	444, 446
Microgaza	422	sculpturatus alcius,	
royanus, Vermetus	442	Petalocochus ...	43 301, 308, 444
rubra,		sculpturatus	
Globigerinoides	306	domingensis,	
ruderalis, Chama	362	Petalocochus ..	445
rugitecta, Turris		scutata, Juliocorbula	410
(Crassispira) ..	549	schideri, Pyrene	
rugosa,		(Eupyrene) ?	499
Anomalocardia	382	schrammi, Engina	495
rugosa, Donax	401	Seila	451
rustica, Thais	497	Seila sp.	451
rutamensis,		Semele	396
Aequipecten		semidecussata,	
(Plagiocentium) ..	20 299, 347	Architectonica	
rutschi,		(Pseudotorinia) ..	46 302, 422, 454, 455
Parametaria	52 303, 312, 500	semidecussata,	
		Architectonica	
		(Pseudotorinia)	
		cf.	46 302, 456
		semidecussatum,	
		Solarium	422
		semiglobosa, Hanetia	303, 308, 512

S

INDEX

semiglobosa			springvaleensis,	
cochlearis,			Conus	58 304, 308, 544
Solenosteira	513		springvaleensis,	
seminudus,			Turbonilla	
Solariorbis	433		(Peristichia)?	564
semistriata, Rotella ..	427		Springvaleia	440
semota, Cancellaria			springvalense,	
(Narona)	58	304, 541	Prunum	
sericifilum,			(Egouena)	57 304, 308, 534
Epitonium	462, 463		springvalensis,	
sericifilum, Epitonium			Fusinus	524
(Asperiscala)			springvalensis,	
aff.	302, 463		Polinices	483
serpentina, Mitra	531		spurca acicularis,	
Serpulorbis	443		Cypraea	479
serratum,			squamosa, Acar	328
Laevicardium	370		stanislasmеunieri,	
sheldoniana, Noetia			Polinices	302, 308, 311,
(Noetia)	17, 18	299, 306, 338		483
simplex, Anomia	21	299, 308, 350	stanislasmеunieri	
simplex, Anomia aff.	350, 351		springvalensis,	
Simplistrigilla	390		Policines	
Sincola	311, 508, 509		(Dallitesta)	483
sincola, Strombina	508		statuminatum,	
Siphocypraea	478		Epitonium	461
Siratus	490		stearnsii, Columbella	
smithiana,			(Seminella)	506
Caryocorbula	39	408	stenopa, Natica	481
Solariorbis	432		stewarti,	
Solariorbis?			Trigoniocardia	
nov.sp.ind.	428		(Americardia)	369
Solecurtus	406		Stramonita	496
Solen	407		strata, Strigilla	390
Solen (Solen)			striata?, Martesia	301, 306, 415
species	300, 407		striata, Muricidea	496
Solena	407		striatula, Niso	467
solida, Acropsis	311, 312, 331		striatum, Crucibulum	474
solidula, Pallacera	517		striatus?, Donax	300, 401
solivaga, Calorhadia			striatus, Pholas ..	415
(Calorhadia)	14	299, 311, 322,	strigilatum,	
		323	Buccinum	561
sophus, Conus	544		Strigilla	389
sowerbiyi, Typhis	493		Strigilla	
sowerbyii, Typhis	493		(Pisostrigilla?)	
spadiceus, Bufo	487		species	300, 390
spelta, Bulla	479		Strioterebrum	558
spinosum, Crucibulum			Strioterebrum species	304, 560
(Crucibulum)	312, 475		Strombiformis	
spiralis, Trochita	473		sp.ind.aff.dalli	464
spirata?,			Strombina	507
Vermicularia	44	301, 442	Strombinophos	510
spirata trilineata,			Strombinophos	
Vermicularia	442, 443		species	303, 511
spretum, Teinostoma			Strombocolumbus	507
(Pseudorotella)	43	301, 427	strongi, Epitonium	461
springvaleensis,			strongianum,	
Cancellaria	539		Epitonium	461

INDEX

stultorum, Cardium	382	tenuis lupina,	
subaequalis, Tagelus	406	Tenuicorbula	414
subangulatus,		tenuis lupina,	
Polinices	484	Tenuicorbula aff.	414
subcerata,		tenuis, Cyclinella	
Nuculana	321	aff.	26 300, 372
subconsors,		tenuis, Dosinia	
Miraclathurella	557	(Artemis)	371
subfilifera, Olivella		tenuis, Mactra	399
(Minioliva)	528	tenuisculpta,	
subibajana, Nuculana	320	Nucula	318
subrostrata, Chione	378	tereбра, Turbo	435
substrom, Crucibulum		terebrale,	
(Crucibulum)47	302, 474	Cerithium	451
subulatum,		terminula, Cythara	551
Cerithiopsis	450	terminula, "Cythara"	
subulatus, Turbo	464	(Brachycythara?) cf.	551
sulcata, Bulla	572	terminula,	
sulcata, Sulcoretusa		Lepicythara	552
aff.	60 305, 572	terryi, Cancellaria	543
sulcata fossilis,		Thais	496
Sulcoretusa	572	Thais (Stramonita)	
sulcata harveyensis,		species A ...	51 303, 497
Sulcoretusa	572	thalia, Anadara	333
sulcata, Cuma	497	thaumastum,	
sulcata, Modiola	341	Trigoniocardia	367
Sulcoretusa	572	thomae, Bursa	486
Sulcularia	572	thomae, Bursa	
suteri, Prunum	535	(Bursa) aff.	49 302, 486
Systellomphalus	433	thompsoni,	
		Aequipten	346
T		thompsoni, Eupleura	492
Tagelus	404	tiarula, Nassa	517
tamatavica, Nucula	316	tigris, Cypraea	478
tampaensis,		tinkeri, Cerithium	447
Eulimella	565	tintinnabularum,	
tecta, Cymia	312, 498	Trachycardium	364
Tectonatica	482	titan, Dosinia	
tectura, Natica	482	(Dosinidia)	370
tectum, Buccinum	497	Tivela	372
Teinostoma	427	Toreula	440
telembus,		toreta, Peristichia	563
Strombinophos	510	trachea, Dentalium	434
Tellidora	389	Trachycardium	363
Tellidora species	300, 389	tranquebaricum,	
tellinoides, Cumingia	401	Buccinum	512
Temnoconcha	395	transversa, Anadara	335
tenera, Barbatia		transversa	
(Fugleria)	329	sanctidavidis,	
tenera, Cancellaria	543	Scapharca	
tenera, Macoma	391	(Scapharca)	334
tensa, Erycina	412	transversus, Donax	404
Tenuicorbula	311, 413	trapezium, Murex	522
tenuilineata,		trema, Cancellaria	542
Eulimella	565	triangularis,	
tenuis, Corbula	413	Cancellaria	540
		triangularis, Noetia	338

INDEX

tribulus, Murex		489	turamensis,		
Trigoniocardia		365	Fasciolaria		
Trigoniocardia			(Pleuroploca)	56	303, 306, 522
(Trigoniocardia)			Turbinella		532
spec.		368	Turbonilla		566
Trigonostoma		543	Turbonilla		
trigonostoma,			species A	60	304, 566
Delphinula		543	Turbonilla		
Trigonostoma			species B	60	304, 567
(Emmonsella)			Turbonilla		
species		304, 543	species C	60	304, 567
trilineata, Turritella		443	Turbonilla		
trilineata,			species D	60	304, 567
Vermicularia (?)	44	301, 442	Turbonilla		
trilineatus, Vermetus		443	species E	60	304, 568
trilix,			turrita, Columbella		
Cyclostremiscus		432	(Anachis)		503
trinidadensis,			turrita, Lepicythara		552
Merisca	33	300, 387	Turritella		435, 441
trinidadensis, Oliva	56	525	Turritella		
trinitaria,			(Bactrospira)		
Apolymetis	34	300, 308, 393	species	45	301, 440
trinitaria			turriteloides,		
colombiensis,			Eulimella		565
Metis		393	Tylaxis		431
trinitaria,			Typhina		493
Eucrassatella	21	299, 308, 351	Typhinellus		493
trinitatensis,			Typhis		493
Nassarius (Uzita)	55	303, 518	Typhis (subgenus ?)		
trinitatis, Eurytellina		386	species		303, 493
trinitatis					
riosecanus, Xancus		532			
Triphora		457			
Triphora species		302, 458			
Triptychus		563	uber, Polinices		311, 484
Triptychus			umbonata, Arca		326
(Peristichia) species		304, 563	umbonata		
tristoma, Cerithium		457	morantensis,		
tritricumtritonis,			Arca		326
Cylichnella		571	undata, Glycymeris		
triticus, Rhizorus		573	(Glycymeris) cf.	18	299, 340
Trivia		477	undula, Macra		383
trochiformis, Trochita		473	uniplicata,		
Trochita		311, 473	Neosimnia cf.	48	302, 479
Trophon		494	uruguayensis, Abra		400
tropidita, Odostomia			urumacoensis,		
(Salassia)		569	Carycorbula		409
tuberaensis,			Uzita		518
Oliva		525			
tubercularis, Murex		449			
tubifer, Crucibulum		475			
tubifer, Purpura		493			
Tucetona		341			
tulipa, Fasciolaria cf.		303, 522			
tulipa, Murex		522			
tumens, Venus		374			

INDEX

Varicorbula	411	vitellus, Nerita	480
variegata, Semele	396	vitreum, Teinostoma	428
variegata, Turritella	439	Vitta	425
variegata, Voluta	531	vittata,	
varium, Bittium	449	Miraclathurella	556
vautrini, Hastula	561	VolSELLA	342
veatchi, Conus	545	Volvarina	535
veatchiana, Chione (Nioche)	28 300, 377	Volvarina (?) species A	57 304, 530
venezuelana, Erato	476	Volvarina (?) species B	57 304, 536
venezuelana, Eucrassatella	352	vulgaris, Nuculana	320
venezuelana, Nucula	317		
venezuelana, Tectonatica	482	W	
venezuelana lavelana, Persicula	537	walli, Chione	378
venezuelanus, Murex	491	malli, Strombina	509
venezuelensis, Parviturbo	424	watsonensis, Architectonica	454
ventricosus, Pecten	345	wetherelli, Acteon	570
ventricosus, Triforis	458	whitei, Tagelus	405
venustus, Brachydontes	341	willardausteni, Anadara	333
verdevilla, Carditamera	358	willcoxiana gunteri, Niso	467
Vermicularia	441	wisewoodae, Neosimnia	480
verreauxi, Olivella (Niteoliva) cf.	55 303, 527	wolfgangi, Terebra	558
vexillata, Plicatula	343	woodii, Cymia	497
vexillum, Pinna	342	woodringi, Mitra	531
vibex, Nassarius (Phrontis)	55 303, 517	woodringi, Vermicularia	442
vicaria, Notocorbula	411		
vieta, Corbula	412	X	
vieta, Nucula (Lamellinucula)	13 299, 312, 316	xenicus, Aesopus	555
virginea, Nerita	425		
virginea, Neritina (Vitta) cf.	43 301, 305, 306, 307, 425	Y	
virginiae, Carditamera	22 357	yaquica, Odostomia	569
virginica, Cochliolepis	431		
virginica, Crassostrea cf.	21 299, 306, 349	Z	
virginica, Ostrea	349	Zanassarina	505
		Zanassarina species	53 303, 505
		zebra zebra, Arca (Arca)	14 299, 306, 325
		ziczac, Ostrea	344
		zizyphinus, Trochus	418
		zonale, Cerithium	446

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